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NEW RADIOCARBON DATES AND THE MAYA CORRELATION PROBLEM *

LINTON SATTERTHWAITE AND ELIZABETH K. RALPH

ABSTRACT

Two long series of samples from Tikal, Petén, Guatemala, have been dated by the radiocarbon method for the purpose of limiting the range of possible correlations of the Maya calendar with the Christian. These samples from lintel and vault beams were selected from latest-growth portions of the beams which were presumably cut at times corresponding to Maya dates carved on lintels of two temples. Christian dates for dedicatory Maya dates of the lintels are calculated according to five correlation hypotheses, and are compared with radiocarbon dates for ten beams from Temple IV and six from Temple I. These new radiocarbon dates are shown to be closely related to "absolute" ages by means of radiocarbon counts of tree-ring-dated samples of the same period. The radiocarbon results support the 11–16 (Goodman-Thompson-Martinez) correlation. Attention is given to previous radiocarbon tests by other laboratories of beams removed from Tikal many years ago which seemed to favor the 12–9 correlation in Spinden or Makemson variants. With the aid of new radiocarbon dates for similar samples, reasons for the differences in results are discussed.

DURING THE 600 years of the Lowland Maya Classic period, carved stone monuments were erected bearing Calendar Round Dates fixed in the Long Count from a single base date. This was accomplished by recording an Initial Series number, or information permitting one to supply it. (Familiarity with the mechanics of the system is assumed.) Usually the carved date, or one of several such dates, can be classed as the dedicatory date — one which was approximately contemporaneous with the carving, and "the date" of the monument as an object.

Unfortunately this highly efficient long-distance dating device did not survive the Classic period, and as a result scholars have struggled for many years with the problem of correlating the Long Count system with the Christian calendar. Various widely differing hypotheses have been proposed and studied. Later in this paper we will provide a checklist of them, including a very recently proposed new one, as yet unpublished. All attempts are founded on varying interpretations of available ethnohistorical, archaeological, and astronomical evidence.

While most surviving chronological inscriptions are on stone, at Tikal (17° 13.3′ N. Lat., 89° 38.5′ W. Long.), Petén, Guatemala, they are also found on the undersides of zapote wood beams used to form lintels over doorways in three buildings. One looked up at the inscriptions and accompanying scene. Thus, in these cases, Christian correlation dates which are proposed for Maya dedicatory dates of the lintels can be checked against radiocarbon dates found for samples from these and other wooden elements of the buildings. J. Laurence Kulp (Kulp, Feely, and Tryon 1951) first took advantage of this situation, using a sample from a carved lintel beam of Structure 10, brought to New York in 1914. Willard F. Libby (1955) applied the same test to samples from two carved lintel beams from Temple IV, which had been taken to Basel, Switzerland, about a century ago. It has since been proved by Coe and Shook (in press) that a legible text thought by Morley to come also from Temple IV came in fact from Temple I. These beams are also at Basel, but two carved beams over another doorway of Temple I are still in situ.

We have made a new attempt to narrow the range of acceptable correlations by means of radiocarbon age determinations, using vault as well as lintel beams for reasons to be discussed later. We have concentrated on Temple IV beams because their dedicatory date can be specified within very narrow limits, and because Libby counted his two samples from that temple for the unusually long period of six weeks. Incidentally, this temple is the tallest known to have been built by the Maya. We chose samples from Temple I, rather than from

* A shorter version of this paper was read by Satterthwaite at the 25th Annual Meeting of the Society for American Archaeology, New Haven, Connecticut, May 7, 1960.

Structure 10, for a second series of radiocarbon datings. We did so because recorded Maya dates indicated that those of Temples IV and I differed considerably in age, while those for Temple IV and Structure 10 exhibited little or no difference in age. Temple I was preferred also because it was and still is being excavated.

For a comparative test we have also radiocarbon-dated a sample duplicating one of the two used by Libby, from Temple IV, and another duplicating that from Structure 10 used by Kulp. For supplying us with these samples we are greatly indebted, respectively, to Alfred Bühler and P. Hinderling of the Museum für Völkerkunde, Basel, and to Gordon F. Ekholm and Junius Bird of the American Museum of Natural History, New York. Our effort follows one other prior radiocarbon dating at Tikal, A.D. 1158±50 for a sample (Y–392) from Structure 60, collected by Stephan Borhegyi (Deevey, Gralenski, and Hoffren 1959: 165). This sample is from logwood and without associated inscriptions. Samples from that building have not been dated by the University of Pennsylvania laboratory.

Our new approach to the problem of correlation was initiated by Froelich Rainey, Director of the University Museum, University of Pennsylvania, and Edwin M. Shook, Field Director of the Museum's Tikal Project, which has operated since 1955 in collaboration with the Government of Guatemala. Under Shook's direction samples from all preserved beams at Tikal have been systematically collected by Aubrey Trik, Project Architect. In this joint report, Elizabeth K. Ralph, Research Associate, Department of Physics, in charge of the University of Pennsylvania Radiocarbon Laboratory (which is sponsored jointly by the Museum and the Department of Physics) is entirely responsible for radiocarbon data and analyses. William E. Stephens, of the Department of Physics, contributed invaluable advice in the important matter of statistical analysis. Robert Stuckenrath, Research Assistant, Radiocarbon Laboratory, processed the samples for dating. Linton Satterthwaite, Curator of the American Section of the Museum, supplied information on Maya dates and correlation hypotheses to be tested. In planning the investment of many months of laboratory time for this study Satterthwaite collaborated with Shook, William R. Coe, Assistant Curator and Assistant Field Director of the Tikal Project, and Ralph. He had previously raised specific cautionary questions in respect to the interpretation of the Kulp and Libby results (Satterthwaite 1956, 1958).

The findings of Kulp and Libby were widely held to validate Spinden's early 12–9 correlation and to disprove Thompson's 11–16 and still later correlations. As will become apparent, our results favor an 11–16 correlation and, we think, render untenable all earlier and later ones. If this conclusion proves acceptable, radiocarbon datings for beams in other Tikal buildings and for certain charcoal subfloor deposits will be easier to evaluate. These will be published in *Tikal Reports*.

The question of correlation is of paramount importance and it justifies, we think, this publication of the basic radiocarbon data and their interpretation. The reader will then be able to appreciate the degree of reliability achieved by the radiocarbon method when applied to an adequate number of properly selected samples.

While each correlation hypothesis places a given Maya Long Count date within a particular Christian year, the radiocarbon method dates an object only within a spread of years. This spread, which allows for statistical uncertainty, cannot be avoided in counting random events such as C^{14} disintegrations. It can be reduced, however, by prolonged measurements of one sample or, with greater reliability, by repeated measurements of several contemporaneous samples. After making the preliminary assumption that vault and lintel beams of a building were essentially contemporaneous we have, therefore, made a total of 33 counting runs for samples from ten different beams of Temple IV, and 17 runs of six different beams of of Temple I.

These two groups of ten and six samples are from beams or parts of beams still at Tikal. After discussing the choice of samples in some detail we demonstrate that the ten beams represented by our Tikal samples from Temple IV are approximately of the same age; that the calibration of the radiocarbon counter, as determined by measurements of samples of known age, was closely related to true ages; and that, as noted already, the results favor an 11–16 Maya-Christian correlation. Our radiocarbon analyses of duplicates of the Kulp and Libby samples, from New York and Basel, are presented and discussed in this connection. The radiocarbon dates for Temple I are then presented. The results for five of the six beams

there confirm results obtained with samples from Temple IV. A single vault beam (Temple I) yielded a radiocarbon age much earlier than the others and we suggest that this beam was actually older than the others, and had been salvaged from an earlier building. In a final section, the Maya dedicatory dates and proposed correlations are discussed and comparisons made with the radiocarbon results.

CHOICE OF BEAMS FOR RADIOCARBON DATING

A sample from the interior of a tree yields a radiocarbon date earlier than that of its death. It is a sample from the latest growth which should provide a date closest to the dedicatory date, when the wood was put to use. Thus, a sample from the interior portion of the tree needs correction for a post-sample growth error when it is compared with a correlation date. The error is in sampling, not in radiocarbon counting. Since we have no quantitative basis for estimating such errors we have chosen samples where they were probably small, and where failure to allow for them should not be significant. This led to the selection of both vault and lintel beams. Some discussion of the two types is indicated, as well as of our assumption that for a given building both types were cut at approximately the same time.

Vault beams of the two temples unite the sides of the vault over each room, and have their ends imbedded in the masonry at two or three levels. Our samples are from the lowest level only, which is somewhat above the level of the lintels. While no doubt the vault beams were placed later than the lintel beams, it seems reasonable to suppose that this lag was no more than a year or two during which the supporting walls were setting. For our purposes, the placement of both types may be considered as contemporaneous.

The vault beams are round in cross section. Presumably trunks of suitable size were selected and used with little working other than stripping the bark. In some cases Trik noted traces of remaining bark, which suggests that workers with stone tools were not averse to labor-saving practices. He made his cuts at the surface, and as shallow as was practicable. Thus, the post-sample growth error for the vault beams must be close to zero.

Although vault beams were *placed* at approximately the same time as the lintel beams, there is no obvious reason why older, sound vault beams salvaged from dismantled buildings should not be re-used without modification, if available. Because of this possibility we must modify our assumption that in each of the temples the ages of vault and lintel beams were the same. Reasons for doubting that lintel beams might also have been re-used are noted below. The radiocarbon results in part confirm the supposition that old vault beams only might be re-used, since the date of one vault beam of Temple I is decidedly earlier than three other vault beams and two lintel beams. For Temple IV, with eight vault beams and two lintel beams, the radiocarbon results indicate contemporaneity for all examples of both types.

The lintel beams were much larger than the vault beams, and they were worked down to square or rectangular shape as seen in cross section. The widths of the several beams of which a particular lintel was composed vary greatly, but collectively they fit the assigned space. It seems unlikely that old lintel beams of appropriate dimensions would be at hand. Furthermore, seasoned zapote wood is hard, and presumably the Maya, with only stone tools, would find it unsuitable for reworking to required sizes, and, especially, for carving. From this point of view, carved lintel beams are preferable to vault beams.

However, with respect to post-sample growth error the vault beam is preferable. All the most recently formed wood of lintel beams was removed in shaping them. Probably the blanks were complete trunks, but use of split trunks or even quarters of trunks cannot be excluded. Presumably the size of the blanks was chosen so as to require a minimum of removal of wood to obtain the desired result. If this was so, one or more of the corners of a beam, as seen in cross section, was probably formed of wood not much older than the youngest wood of the original complete trunk. Thus it may be assumed that the post-sample growth error will be small if the sample comes from the latest wood left on a lintel beam.

To be sure that one has such a sample it is necessary to observe the pattern of rings on a cross section, and this is not possible while the beam is in situ with its ends buried in masonry. However, at both temples chopped-off butt ends of removed beams are still available and in these cases Trik sampled the latest remaining wood, as indicated by his examination of

their cross sections. He also supplied us with sketches of the cross sections. With these as guides we confined our radiocarbon counts for lintel beams to samples from four butt ends which were sufficiently well-preserved to indicate that the samples represented the latest growth left by the Maya woodworker. With these precautions we assume that post-sample growth errors for these four lintel beams are small enough to be disregarded.

In both Temples IV and I there are three rooms, entered by doorways oriented on the front-rear axes. We followed established practice in numbering the rooms and the lintels from front to rear. In both buildings, only the interior lintels (Nos. 2 and 3) were carved. Coe and Shook (in press) have made a thorough study of all carved lintel beams now at Tikal and elsewhere and of the impressions in the mortar of the buildings made by lintels which had been removed, and have lettered individual beams from front to rear (a, b, c, etc.). They have shown that the sampled butt ends from which our samples were taken were from two different beams at each temple. For identification Trik has numbered all vault beams, starting with the lowest level in each room. His designations appear in our Tables 1 and 10, along with sample numbers and, for convenience, separate reference numbers.

Our four butt ends of lintel beams were found in the temples, where they had been chopped off and separated from carved portions now at Basel. The backs of the latter were also chopped away to lighten them further so that they could be carried off in the form of planks. Our duplicate of one of Libby's two samples is from the plank resulting from this modification of Beam *a* of Lintel 3 of Temple IV, which originally was about 35 cm. wide and 21 cm. thick. The samples (our P–282 and Libby's C–948) are from long cuts across the grain and, of course, on the back, as was the case with Kulp's sample and our duplicate from Structure 10 (our P–293 and Kulp's L–113). In these cases of samples which are definitely from the interior (that is, older) wood, it seems proper to assume that the post-sample growth error may have been significant. This postulate is confirmed by the radiocarbon dates.

All beams discussed are of zapote, as determined by George K. Brizicky, Assistant Curator, S. J. Record Memorial Collection, School of Forestry, Yale University, who examined portions of the samples. These received the standard treatment with hydrochloric acid for removal of inorganic carbon compounds after all remains of termites had been carefully picked out (see Ralph 1959a). A few samples (noted in Table 1) were treated with sodium hydroxide to test for possible humic acid contamination. The results were negative.

The New Radiocarbon Dates

The radiocarbon dates were determined with a carbon dioxide proportional counter with specifications as described previously (Ralph 1959b). We present in Table 1 and Figure 1 a summary of the radiocarbon dates for Temple IV. The calculations of the standard deviations of the average for each beam are explained below along with the data in Tables 2 and 3, and, those for the over-all average in Table 5. This latter analysis confirms the assumption that the ten Temple IV beams are contemporaneous. The bases for the calculations of Tikal ages (the modern oak determinations) are analyzed in Table 6, and the verification of this calibration — the tree-ring-dated analyses — in Table 7 and Figure 3. These are followed by data and discussions of radiocarbon dates of beams for Temple IV from the Museum in Basel, Switzerland, and of a similar one from Structure 10 (now in the Museum of Natural History, New York), and of dates for Temple I.

In Figure 1 the individual averages of the ten beams from Temple IV, the over-all average of these beams, and our measurements as well as the previous determinations of the supposedly contemporaneous Swiss beams by the Chicago laboratory are plotted along with five correlation hypotheses (discussed later). The vertical, thick black line for each radiocarbon date represents the standard statistical deviation — namely, 1 σ (sigma), and the thin extension of the thick line, 2 σ. The probability, in the case of a Gaussian distribution (which the data in the Explanation below indicate this to be), that the deviation from the "exact" value will be greater than $\epsilon\sigma$ (multiples of sigma) is:

If the deviation is:	*the chances that the exact value lies outside of this ± range are:*
1σ (thick black vertical lines)	1 in 3
2σ (thin extensions of 1σ lines)	1 in 22
3σ	1 in 370
4σ	1 in 10,000
5σ	1 in 1,000,000

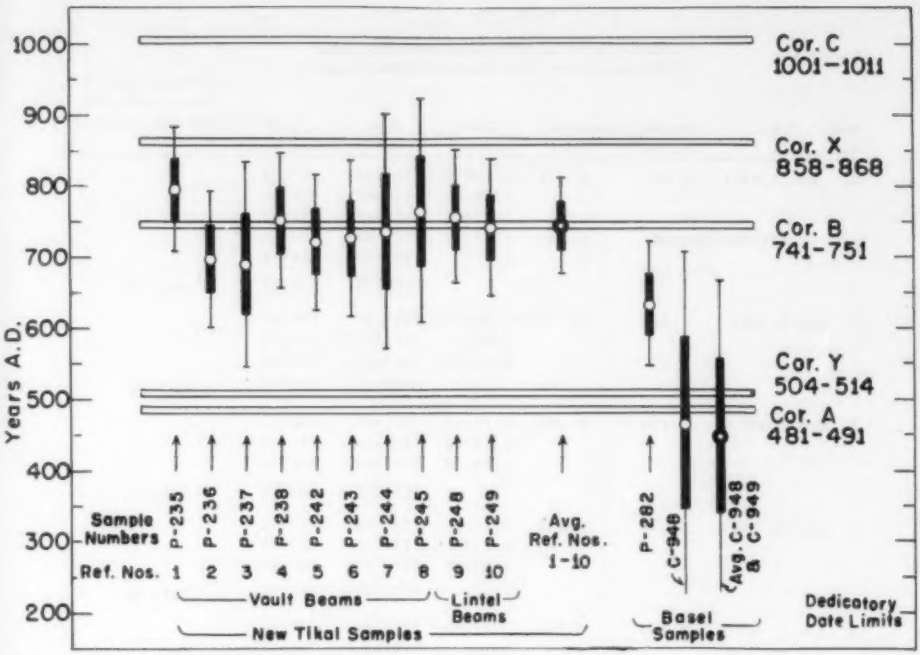

FIG. 1. Radiocarbon dates for Tikal Temple IV compared with Maya Long Count correlation hypotheses. Thick black vertical bars represent standard statistical deviations (1 sigma) including half-life error of radiocarbon dates for the indicated samples. Thin line extensions of thick vertical bars represent two standard statistical deviations (2 sigma). Lower and upper sides of hollow horizontal bars are at Christian calendar year positions corresponding to 9.15.10.0.0 and 9.16.0.0.0, respectively (as dedicatory date limits), according to the indicated correlation hypotheses.

KNOWN-AGE SAMPLES

An analysis of the Tikal data is not complete without an equivalent study of the measurements of samples of known-ages — the foundations of the age calculations. There are two phases of the known-age bases to be considered: first, the normal "zero age" calibration and associated counting efficiency checks made with 100-year-old oak samples, and second, the determinations of radiocarbon ages of dendrochronologically analyzed samples selected from trees which died (and ceased to incorporate C^{14}) at approximately the same time that our Tikal trees (the sources of the temple beams) were cut. The radiocarbon method of age determination is possible because of the fact that when a living organism, such as the outer growth ring of a tree, dies, it is no longer in equilibrium with the atmospheric $C^{14}O_2$, but begins to lose its maximum zero age C^{14} at a rate dependent upon the half-life of C^{14}.

If we could take some leaves or outer rings of living trees, for example, and if it had been proven that the cosmic ray intensity had not fluctuated in the past, the "zero age" starting point for age calculation would present no problem. We should simply determine the counting rate of the leaves and by means of the exponential decay equation (which includes the C^{14} half-life 5568 ± 30 years), calculate the age of the unknown sample. This is illustrated graphically in Figure 2. Unfortunately, we cannot measure this zero age value directly because the radiocarbon content of the present-day atmosphere has been disturbed by man. It was depleted (Suess effect) during the past 100 years by the combustion of "dead" carbon products (fossil fuels) and more recently, it has increased because of the nuclear bomb tests. Therefore, we avoid this condition by measuring samples with known ages of 100 years or more. When the counting rates of these are corrected to zero age (by means of the decay

TABLE 1

TIKAL TEMPLE IV RADIOCARBON DATES
(With tolerances from data in Tables 2 and 3)

Ref. No.	Beam No.	Museum	Lab.	Date Counted	Age Years B.P.	Age A.D. Years	Average Age, A.D. Years, with ± 30 half-life uncertainty included.
1.	Rm. 2, VB 1	T-267	P-235	2/11/59	1196±64	763±64	
				2/14/59	1123±62	836±62	
				2/17/59	1126±63	833±63	
	(second portion)		P-235	5/27/59	1176±65	783±65	
				6/1/59	1195±46	764±46	
					1163±33	796±33	796± 44
2.	Rm. 2, VB 2	T-268	P-236	1/8/59	1263±65	696±65	
				1/9/59	1263±65	696±65	
				1/14/59	1261±65	698±65	
					1262±38	697±38	697± 48
3.	Rm. 2, VB 3	T-269	P-237	1/15/59	1271±65	688±65	
				1/16/59	1204±64	755±64	
				1/24/59	1331±65	628±65	
					1269±65	690±65	690± 72
4.	Rm. 2, VB 4	T-270	P-238	3/6/59	1210±64	749±64	
				3/7/59	1237±65	722±65	
				3/13/59	1175±64	784±64	
					1207±38	752±38	752± 48
5.	Rm. 3, VB 1	T-274	P-242	3/18/59	1278±64	681±64	
				5/1/59	1181±57	778±57	
				5/6/59	1253±65	706±65	
					1237±38	722±38	722± 48
6.	Rm. 3, VB 2	T-275	P-243	3/15/59	1210±64	749±64	
				3/16/59	1253±64	706±64	
					1232±46	727±46	727± 55
7.	Rm. 3, VB 3	T-276	P-244	4/20/59	1166±46	793±46	
				5/4/59	1275±48	684±48	
					1222±77	737±77	737± 83
8.	Rm. 3, VB 4	T-277	P-245	3/3/59	1125±64	834±64	
				3/14/59	1081±63	878±63	
				3/20/59	1255±64	704±64	
				3/21/59	1220±64	739±64	
	(second portion, NaOH pretreatment)		P-245	3/28/59	1238±55	721±55	
				3/30/59	1240±50	719±50	
					1193±73	766±73	766± 79
9.	L.3, a, d or f	T-478	P-248	4/9/59	1182±64	777±64	
				4/17/59	1210±64	749±64	
				4/25/59	1211±63	758±63	
					1201±36	758±36	758± 47
10.	L.3, e or g	T-484	P-249	5/14/59	1168±50	791±50	
				5/21/59	1218±65	741±65	
	(Second portion, NaOH pretreatment)		P-249	5/20/59	1261±66	698±66	
					1216±38	743±38	743± 48

Average age of 13 samples from 10 beams (1-10), from data in Table 5, with ± 30 half-life uncertainty included = 746± 34
(From statistical uncertainties alone, without ± 30 half-life uncertainty, the standard deviation of the average is ± 16 years).

TABLE 2

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TEMPLE IV BEAM DATA

Date Counted	(Total n_t Count)	(Net n_n Count)	$n_n - \bar{n}_n$	$(n_n - \bar{n}_n)^2$
		Beam No. 1 (P-235)		
2/11/59	37,102	27,699	-113	12769
2/14/59	37,214	27,950	+138	19044
2/17/59	37,206	27,942	+130	16900
5/27/59	38,440	27,768	- 44	1936
6/1/ 59	38,414	27,703	-109	11881
	$\bar{n}_t$ = 37,675	$\bar{n}_n$ = 27,812	Σ = + 2	Σ = 45630
		Beam No. 2 (P-236)		
1/8/59	37,130	27,468	- 3	9
1/9/59	37,287	27,469	- 2	4
1/14/59	37,273	27,475	+ 4	16
	$\bar{n}_t$ = 37,230	$\bar{n}_n$ = 27,471	Σ = - 1	Σ = 29
		Beam No. 3 (P-237)		
1/15/59	37,449	27,441	+ 11	121
1/16/59	37,682	27,674	+222	49284
1/24/59	37,152	27,240	-212	44944
	$\bar{n}_t$ = 37,427	$\bar{n}_n$ = 27,452	Σ = - 1	Σ = 94349
		Beam No. 4 (P-238)		
3/6/59	37,273	27,652	- 8	64
3/7/59	37,180	27,559	-101	10201
3/13/59	37,309	27,770	+110	12100
	$\bar{n}_t$ = 37,254	$\bar{n}_n$ = 27,660	Σ = + 1	Σ = 22365
		Beam No. 5 (P-242)		
3/18/59	36,834	27,418	-140	19600
5/1/59	37,960	27,751	+193	37249
5/6/59	37,781	27,504	- 54	2916
	$\bar{n}_t$ = 37,525	$\bar{n}_n$ = 27,558	Σ = - 1	Σ = 59765
		Beam No. 6 (P-243)		
3/15/59	37,069	27,653	+ 75	5625
3/16/59	36,918	27,502	- 76	5776
	$\bar{n}_t$ = 36,993	$\bar{n}_n$ = 27,578	Σ = - 1	Σ = 11401
		Beam No. 7 (P-244)		
4/20/59	37,498	27,804	+188	35344
5/4/59	37,636	27,428	-188	32400
	$\bar{n}_t$ = 37,568	$\bar{n}_n$ = 27,616	Σ = 0	Σ = 67744
		Beam No. 8 (P-245)		
3/ 3/59	37,565	27,944	+232	53824
3/14/59	37,640	28,101	+389	151321
3/20/59	36,912	27,496	-216	46656
3/21/59	37,034	27,618	- 94	8836
3/28/59	37,223	27,563	-149	22201
3/30/59	37,210	27,548	-164	26896
	$\bar{n}_t$ = 37,264	$\bar{n}_n$ = 27,712	Σ = - 2	Σ = 309734
		Beam No. 9 (P-248)		
4/ 9/59	37,452	27,748	+ 66	4356
4/17/59	37,346	27,652	- 30	900
4/25/59	37,856	27,647	- 35	1225
	$\bar{n}_t$ = 37,551	$\bar{n}_n$ = 27,682	Σ = + 1	Σ = 6481
		Beam No. 10 (P-249)		
5/14/59	38,149	27,795	+163	26569
5/21/59	37,997	27,623	- 9	81
5/20/59	37,852	27,478	-154	23716
	$\bar{n}_t$ = 37,999	$\bar{n}_n$ = 27,632	Σ = 0	Σ = 50366

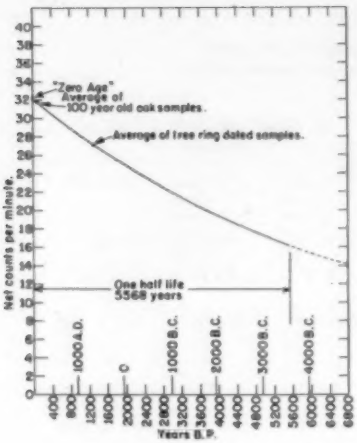

FIG. 2. Exponential decay curve of C^{14}.

equation), a firm basis for age calculation should then be established. This correction for zero age may be visualized in Figure 2. From the curve, the average counting rate of our 100-year-old oak samples is seen to be 31.75 counts per minute. We then follow the exponential decay curve up to the point where it intersects the vertical axis of the graph. This point gives us our zero age counting rate. However, there is another problem to consider, and that is the constancy of the cosmic ray intensity, one of the basic principles of the radiocarbon method. Recent measurements of known age samples in this laboratory and others suggest that small fluctuations in cosmic ray intensity may have occurred in past eras. These indicate that the possible fluctuations were less than 2% in magnitude for the past 2000 years, but for the Maya calendar correlation it is important to ascertain the limits of these suspected fluctuations within this range of time. It is for this reason that radiocarbon results of four tree-ring-dated samples (contemporaneous with the Tikal era under study) have been included in this article.

In order to arrive at a base, the ensuing procedure was followed. We analyzed first the 100-year-old oak measurements. These gave us our zero age base for age calculations and if the individual counts of the oaks are consistent, they show that the efficiency of the counter has been stable over the period of the Tikal and of the tree-ring measurements. They also serve as a basis of comparison with future results of other laboratories because the C^{14} content of oak (corrected for zero age) is 95% of the International Oxalic Acid Standard (National Bureau of Standards No. 4990), which is the value (95%) for use in future age calculations that was agreed upon by laboratories which were represented at the radiocarbon conference in Groningen in September 1959 (Godwin 1959.)

TABLE 3

STANDARD DEVIATIONS (SIGMAS) FOR BEAMS FROM TEMPLE IV DERIVED FROM DATA IN TABLE 2
Where $\bar{T} = 1000$, $\bar{b} = 10,000$

Beam No.	N	σ_n	σ_t	σ_a	Accepted Sigma / $\bar{T}$
1	5	109	194	106	0.106
2	3	4	193	125	0.125
3	3	218	194	126	0.218
4	3	105	193	125	0.125
5	3	173	194	126	0.126
6	2	107	192	153	0.153
7	2	260	194	154	0.260
8	6	249	193	89	0.249
9	3	57	194	126	0.126
10	3	159	195	126	0.126

The counting and statistical data for the oak determinations are presented in Table 6. In this case, σ_n is slightly greater than σ_t but the measurements do pass the chi-square (χ^2) test. The χ^2 test provides a means of ascertaining whether or not differences in values are significant. Therefore, we may assume that our counter efficiency was stable during the months of these runs, that the specified ages of the different samples were correct, and we may use the average value (32.146 counts/minute) with a standard deviation of ± 0.040 c/m for the calculations of the ages of the Tikal samples.

Now we may ask whether this zero age value is correct with the possible cosmic ray intensity

TABLE 4

DATA FOR χ^2 TEST FOR TEMPLE IV BEAMS NOS. 1 TO 10

Beam No.	χ^2	N - 1	$P(\chi^2)$
1	1.64	4	0.80
2	0.001	2	0.97
3	3.44	2	0.18
4	0.81	2	0.65
5	2.17	2	0.32
6	0.41	1	0.50
7	2.45	1	0.12
8	11.18	5	0.05
9	0.23	2	0.90
10	1.82	2	0.40

Values of $P(\chi^2)$ found in Segre, 1959, Table 5, p. 32.
Values of χ^2 which indicate a probability corresponding to $P(\chi^2) \geq 0.10$ are acceptable.

TABLE 5

TEMPLE IV DATA FOR OVER-ALL AVERAGE AGE CALCULATION AND ANALYSIS FOR CONTEMPORANEITY

Date Counted	n_t (Total Count)	n_n (Net Count)	$n_n - \bar{n}_n$	$(n_n - \bar{n}_n)^2$
1/8/59	37,130	27,468	-171	29241
1/9/59	37,287	27,469	-170	28900
1/14/59	37,273	27,475	-164	26896
1/15/59	37,449	27,441	-198	39204
1/16/59	37,682	27,674	+ 35	1225
1/24/59	37,152	27,240	-399	159201
2/11/59	37,102	27,699	+ 60	3600
2/14/59	37,214	27,950	+311	96721
2/17/59	37,206	27,942	+303	91809
3/3/59	37,565	27,944	+305	93025
3/6/59	37,273	27,652	+ 13	169
3/7/59	37,180	27,559	- 20	400
3/13/59	37,309	27,770	+131	17161
3/14/59	37,640	28,101	+462	213444
3/15/59	37,069	27,653	+ 14	196
3/16/59	36,918	27,502	-137	18769
3/18/59	36,834	27,418	-221	48841
3/20/59	36,912	27,496	-143	20449
3/21/59	37,034	27,618	- 21	441
3/28/59	37,225	27,563	- 76	5776
3/30/59	37,210	27,548	- 91	8281
4/9/59	37,452	27,748	+109	11881
4/17/59	37,346	27,652	+ 13	169
4/20/59	37,498	27,804	+165	27225
4/25/59	37,856	27,647	+ 8	64
5/1/59	37,960	27,751	+112	12544
5/4/59	37,637	27,428	-221	48841
5/6/59	37,781	27,504	-135	18225
5/14/59	38,149	27,795	+156	24336
5/20/59	37,852	27,478	-161	25921
5/21/59	37,997	27,623	- 16	256
5/27/59	38,440	27,768	+129	16641
6/1/59	38,414	27,703	+ 64	4096
	$\bar{n}_t$ = 37,456	$\bar{n}_n$ = 27,639	Σ = + 46	Σ = 1,093,948

variations included, or, in other words, with the effective half-life value for age calculation taken into consideration. For this question, we examine four tree-ring-dated sample measurements shown in Table 7 in which we have corrected the values to zero age for comparison with the oak measurements. This table includes sub-averages for three of the four samples for which several counts were made and the over-all average of the four different samples. The descriptions of these samples are presented in Table 8.

From Table 7 we find that the average counting rate (corrected for zero age) with appropriate tolerance is then $32.243 \pm .235$ c/m. It will be noted that σ_n is slightly greater than σ_t but the measurements do pass the χ^2 test. Therefore, we conclude that there are no significant deviations from true ages, and indirectly negligible cosmic ray intensity fluctuations.

Next let us examine the effect of this small difference in zero age on the age calculations. This difference is too small to be seen in Figure 2 because of the large time scale (6000 years) covered in this graph. We have, therefore, plotted these deviations as percentage differences from our zero age oak value in Figure 3. The average indicates that our uncertainty in counting rate for absolute age determination in the period of approximately A.D. 700 (from possible cosmic ray intensity fluctuations or incorrect counter calibration), is less than 1%. Such an uncertainty, if real, would be in addition to the statistical deviations listed previously. To evaluate the magnitude of this in terms of age, we find the average counting rate and appropriate tolerance of the four tree-ring-dated samples, after first correcting the actual counting rates to the average age of the four samples (1248 years B.P.). This figure is 27.609 ± 0.202 c/m. We compare this with the average counting rate of the 33 measurements of the ten beams from Temple IV (27.639 ± 0.038 c/m) and find that the difference is -0.030 ± 0.206 c/m, or, in terms of years, -9 ± 60. In other words, on this basis the average age for Temple IV is A.D. 720 (1248–9 B.P.) ± 60. The measurements of the tree-ring-dated samples have, therefore, confirmed the radiocarbon dating with regard to absolute age, but with a somewhat greater uncertainty because of the limited number of measurements.

Comments on the significance of our dating in relation to correlation hypotheses appear later in this article, but a brief preview is pertinent here. Turning to Figure 1, it is apparent that, from statistical considerations alone, the spread of the standard deviation of the average

TABLE 6

OAK MEASUREMENTS FOR "ZERO AGE" COUNTER CALIBRATIONS

Lab No.	Known Age	Date Counted	n_t (Total Count)	n_n (Net Count of for Zero Age)	Correct-	$n_n - \bar{n}_n$	$(n_n - \bar{n}_n)^2$
P-138	186±10	1/21/58	40,448	31,812	-334		111,556
		2/1/58	41,213	32,165	+ 19		361
		3/5/58	40,659	32,091	- 55		3,025
P-139	176±10	6/16/58	40,000	31,966	-209		40,000
		6/24/58	40,857	31,770	-367		134,689
		5/20/58	40,304	31,719	-427		182,329
		5/22/58	40,784	32,087	- 59		3,481
		5/29/58	40,869	32,029	-117		13,689
		6/23/58	40,200	32,008	-138		19,044
		7/9/58	40,757	32,564	+418		174,724
		7/21/58	40,469	32,352	+356		36,336
		7/30/58	39,915	32,043	-183		33,489
		9/8/58	40,518	32,217	+ 71		5,041
		10/16/58	40,113	32,006	+160		25,600
		11/7/58	39,845	32,301	+195		24,025
		11/28/58	39,481	32,049	- 97		9,409
		12/10/58	39,639	32,208	+ 62		3,844
		12/22/58	39,913	32,272	+126		15,876
		1/7/59	40,217	32,103	- 43		1,681
		1/19/59	40,575	32,131	- 15		225
P-241	179±10	1/2/59	39,751	31,935	-311		66,521
		2/10/59	40,991	32,390	+194		33,716
		2/18/59	40,014	32,323	+377		142,129
		3/23/59	39,955	32,267	+121		14,641
		4/6/59	41,032	32,035	-111		12,321
P-252	189±5	4/16/59	41,136	31,871	-275		75,625
		4/27/59	41,716	31,936	-208		43,264
		5/12/59	41,797	31,924	-220		48,400
P-252-A		6/30/59	40,953	32,764	+618		381,924
P-252-B		6/26/59	40,384	32,325	+179		32,041
P-276	113±13	7/21/59	41,979	32,252	+106		11,236
		8/3/59	42,314	32,129	- 17		289
		8/10/59	42,389	32,411	+265		70,225
			$\bar{n}_t$ = 41,960	$\bar{n}_n$ = 32,146	Σ = - 8		Σ = 1,700,976

σ_{n_t} = 231; σ_t = 205, σ_{n_n} = 90
Σ = 40.97, 30-1 = 32, $P(\chi^2) > 0.1$

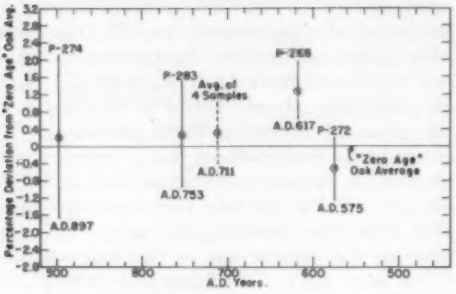

Fig. 3. Percentage deviations of radiocarbon counts from tree-ring dates. All counting rates are corrected to "zero age" by means of the decay equation with half-life value of 5568 years. See Table 8 for descriptions of samples.

for ten beams would have to be increased four times to include Correlation X (the closest in age to B). Or, in other words, the chance of any date within the limits of Correlation X being the true one is of the order of one in 10,000, and more remote for Correlations A, Y, and C. The control measurements of tree-ring-dated samples provide additional support for the agreement of our radiocarbon dates with Correlation B, but because of the greater statistical uncertainty of the limited number of tree-ring measurements, we can say only that our reliability in terms of measured counting rates is within 1%. This is in addition to the statistical uncertainty, but is independent of half-life error, cosmic ray intensity fluctuations, and other methodological problems. If we were to expand our standard deviation for the average of ten beams shown in Figure 1 to cover the uncertainty in respect to absolute ages (based on the tree-ring measurements), the chance that Correlation X is correct is still only one in 22. For the others, not so close to Correlation B, the chances are one in 370 for Correlation Y, and one in 10,000 for Correlations A and C.

Temple IV

Our report of Temple IV dates would not be complete without a discussion of the two beams (Chicago samples C–948 and C–949) dated by W. F. Libby in 1954 (Libby 1955: 132) and our recent dating of an adjacent portion of C–948 (Pennsylvania sample P–282). C–948 and P–282 were taken from the same region in Beam *a*, Lintel 3; and C–949 from Lintel 2. Both of these lintels, as noted previously, were removed from Temple IV, reduced in size, and transported to the Museum für Völkerkunde in Basel, Switzerland, many years ago. Therefore, it seems certain that the portions used for radiocarbon dating were taken from inner rings of the trees from which the lintel beams were fashioned, and, therefore, are not representative in age of the Maya dates inscribed on them. More difficulty was experienced with the purification of the carbon dioxide (counting gas) from sample P–282 than with our other Tikal samples but the reason for this is not apparent. The average value of the radiocarbon dates determined by Libby (A.D. 451±110), the Libby radiocarbon date (C–948) for Beam *a*, Lintel 3 (A.D. 469±120), and our value for P–282, an adjacent portion of C–948, (A.D. 636 ±44) are plotted in Figure 1. Our data are listed and analyzed in our usual manner in Table 9.

At first glance it appears that our dating of Beam *a*, Lintel 3 differs from that of Libby's, but if we tabulate these values, the difference is of questionable significance.

Pennsylvania sample P–282	636±44
Chicago sample C–948	469±120
Difference	167±128
Pennsylvania average for ten beams from Temple IV	746±34
Pennsylvania sample P–282	636±44
Difference	110±56

The standard deviation of the difference is the square root of the sum of the squares of the individual measurements. The difference be-

TABLE 7

DATA FOR TREE-RING-DATED SAMPLES

Lab. No.	Known Age B. P. Years	Date Counted	n_i (Total Count)	n_i (Net Count Corr. for "Zero Age")	$n_i - \bar{n}_n$	$(n_i - \bar{n}_n)^2$
P–272	1384	6/5/59	37,527	31,857	–123	15129
		6/5/59	37,800	31,834	–146	21316
		7/13/59	37,723	32,250	+270	72900
			$\bar{n}_t$ = 37,683	$\bar{n}_n$ = 31,980	$\Sigma n_i - \bar{n}_n$ = 1	Σ=109345
			σ_{n_t} = 234.	σ_{n_n} = 196.	σ_{n_n} = 139	
P–274	1062	7/2/59	39,223	32,634	+415	172225
		7/11/59	38,506	31,804	–415	172225
			$\bar{n}_t$ = 38,865	$\bar{n}_n$ = 32,219	Σ = 0	Σ=344450
			σ_{n_t} = 587.	σ_{n_t} = 197.	σ_{n_n} = 172	
P–283	1207	1/8/60	38,937	32,496	+271	73441
		1/25/60	38,142	31,952	–271	73441
			$\bar{n}_t$ = 38,540	$\bar{n}_n$ = 32,223	Σ = 0	Σ=146882
			σ_{n_t} = 384.	σ_{n_t} = 196.	σ_{n_n} = 142	
P–272	1384	average	37,683	31,980	–243	59149
P–274	1062	average	38,865	32,219	– 24	576
P–268	1342	12/29/59	38,635	32,551	+308	94864
P–283	1207	average	38,540	32,223	– 20	400
			$\bar{n}_t$ = 38,633	$\bar{n}_n$ = 32,243	$\Sigma n_i - \bar{n}_n$ = 1	Σ=154989

σ_{n_t} = 235, σ_{n_t} = 196, σ_{n_n} = 100

χ^2 = 5.12 N–1 = 3, $P(\chi^2)$ = 0.15

TABLE 8

DESCRIPTIONS OF TREE-RING-DATED SAMPLES

These samples were dated by the Laboratory of Tree-Ring Research, University of Arizona, Tucson, Arizona. Nos. P-272, P-274, and P-268 were obtained directly from the University of Arizona; P-283, from the University of Utah, Salt Lake City, Utah. We wish to express our appreciation to Terah L. Smiley (University of Arizona) and to Jesse D. Jennings (University of Utah) for these important contributions to the project.

P-272 Douglas fir, Broken Flute Cave, Red Rock Valley, west of Shiprock, Arizona (36° 45' N Lat, 108° 50' W Long). Samples from Room 6, northeast post, No. MLK - 127. Extends over period A. D. 521 - A. D. 624. Rings marked A. D. 570-A. D. 580 processed; average expected age = A. D. 575 (1384 B. P.).

P-274 Pine, Chaco Canyon, N. M., Chetro Ketel (36° 05' N Lat, 107° 55' W Long). Sample extends over period A. D. 883 - A. D. 1038; A. D. 883 represents the pith year. Rings marked A. D. 897 - A. D. 916 processed; average expected age = A. D. 907 (1062 B. P.).

P-268 Douglas fir, Broken Flute Cave. Same specimen as P-272. Rings marked A. D. 610 - A. D. 624 processed; average expected age = A. D. 617 (1342 B. P.).

P-283 Douglas fir, Nine Mile Canyon, Utah (39° 45' N Lat, 110° 40' W Long). Collected by John Gillin around 1930. University of Utah, Museum of Anthropology, No. 21754; 13-3. Sample extends over period A. D. 725 - A. D. 1055. Rings marked A. D. 725-A. D. 781 processed. In this sample, A. D. 725 represents the pith year. Average expected age = A. D. 753 (1207 B. P.).

TABLE 9

RADIOCARBON DATA FOR P-282, TEMPLE IV, LINTEL 3, BEAM *a*

(Sample obtained from Museum für Völkerkunde, Basel, Switzerland)

Date Counted	n_t	n_n	$n_n - \bar{n}_n$	$(n_n - \bar{n}_n)^2$
10/6/59	38,406	27,485	+220	48400
11/20/59	45,448	27,304	+ 39	1521
11/27/59	37,868	27,077	-188	35344
12/21/59	38,183	27,352	+ 87	7569
1/14/59	37,747	27,109	-156	24336
	$\bar{n}_t$ = 39,530	$\bar{n}_n$ = 27,265	Σ = + 2	Σ = 117170
	σ_n = 171,	σ_t = 199,	$\sigma_{\bar{n}}$ = 100	

$\chi^2 = 4.30$, $N - 1 = 4$

$P(\chi^2) = 0.4$ (Passes test)

Average (for age calculation) = 27.265 ± .100 c/m

Age (with ± 30 half-life error included = 1291 ± 44 years B. P.
= A. D. 636 ± 44

tween Libby's and our measurement of Beam *a*, Lintel 3 is 1.3 sigma (167 divided by 128) whereas, in contrast, the difference between our dating of P–282 and the ten representative beams (Ref. No. 1–10) is about two sigma.

The small difference in dates obtained by the two laboratories is not surprising, and may be due partly to our failure to date an exact duplicate of sample C–948, that is, ours may have been from a portion of the beam farther away from the center of the tree, and not the desired exact duplicate. In addition, even though the Chicago laboratory counted the two Temple IV samples for prolonged periods (six weeks each), we surmise that because of the limitations of the method in 1954, the uncertainties were somewhat greater than statistics alone.

We have described the positions from which the samples supplied to Libby (and Kulp) came, and have suggested that a substantial post-sample growth error needs to be allowed for. The significant 110-year difference, when compared with our average for ten beams (with minimal error of this sort) is in the expected direction. We conclude that these Basel samples were not properly representative of true ages, that is, dedicatory dates, and that this accounts for a substantial part of the discrepancy between our average results for samples from ten beams, collected recently at Tikal, and Libby's for two beams and ours from one now at Basel.

Structure 10

Recorded Maya dates indicate that the dedicatory dates of lintels in Temple IV and Structure 10 differed by ten years or less. Therefore, a comparison similar to that for Temple IV is in order, using the result of the Columbia laboratory for a beam from Structure 10 and ours for a supposed duplicate. This beam had been reduced in size and transported to New York in 1914. The radiocarbon dates are as follows:

L–113 (Columbia) counted in 1958 (Broecker, Olson, and Bird 1959) gives a date of A.D. 456±60. This recent count was obtained by converting to carbon dioxide the solid carbon used for the previous determination (Kulp, Feely, and Tryon 1951). This new value is within the statistical spread of the earlier solid carbon count which was A.D. 481±120 years.

P–293 (Pennsylvania) gives a date of A.D. 606±57. This is an average of two counts, A.D. 625±76 (run October 26, 1959) and A.D. 587±73 (run January 20, 1960).

Our differences are tabulated in the same manner as for Temple IV, assuming that, ideally, results for Structure 10 would be the same as those for Temple IV.

Pennsylvania sample P–293	606±57
Columbia sample L–113	456±60
Difference	150±83 = 1.8 sigma
Pennsylvania average for ten beams from Temple IV	746±34
Pennsylvania sample P–293	606±57
Difference	140±66 = 2.1 sigma

Our comments in respect to the Basel samples from Temple IV are also applicable here. The differences in "central" radiocarbon dates are of the same order of magnitude. There are no obvious explanations for the greater discrepancy between the two laboratories in this case other than chance (these were single sample measurements) and failure to duplicate exactly the Columbia sample with respect to tree-growth. If Structure 10 was, in fact, ten years older than Temple IV, the 140-year divergence from ideal expectations with respect to P–293 would be reduced to 130 years, still two standard deviations (two sigma). We conclude that both samples antedated the dedication of the building because of post-sample growth error.

Temple I

We have included radiocarbon dates for six beams from Temple I. These were processed as a check on the results of Temple IV. Since the recorded dates indicated an earlier age for Temple I, we expected consistently earlier radiocarbon dates, which would be in agreement with the same correlation. With one exception the dates confirmed our expectations.

The radiocarbon dates are reported in Table 10 and Figure 4. The data for the calculations of the average ages of each beam and the standard deviations of the averages are presented in Tables 11 and 12; those for the over-all average and deviation, in Table 14. The values for the χ^2 test for statistical consistency of the beam measurements are found in Table 13.

The most striking feature of Table 10 and of Figure 4 (shown also in the statistical analysis) is the difference in age between beam P–229 (Ref. No. 6) and the other five. We assume that it is an older, re-used beam. This interpretation is supported by the report of Brizicky dated July 23, 1959 in which he states: "This sample [P–229] differs from the other samples in very scarce gum deposits and somewhat brittle wood. However, these differences do not seem to be of a specific character." Brizicky also identified the six beams as *Achras* sp. probably *A. zapota*.

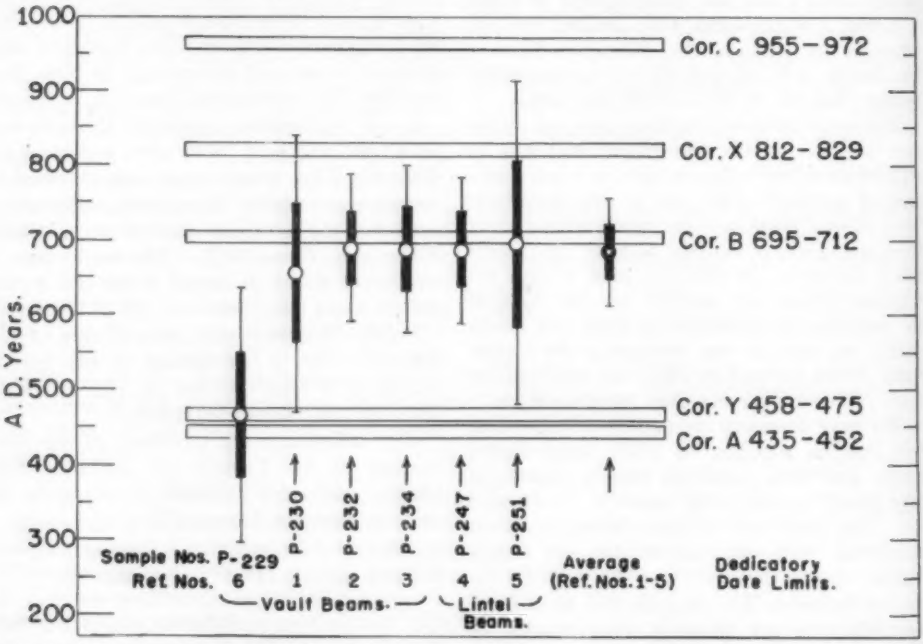

Fig. 4. Radiocarbon dates for Tikal Temple I compared with Maya Long Count correlation hypotheses. Thick black vertical bars represent standard statistical deviations (1 sigma) including half-life error of radiocarbon dates from Table 10. Thin line extensions of thick vertical bars represent two standard statistical deviations (2 sigma). Lower and upper sides of hollow horizontal bars are at Christian calendar year positions corresponding to 9.13.3.0.0 and 9.14.0.0.0, respectively (as dedicatory date limits), according to the indicated correlation hypotheses.

TABLE 10

TIKAL TEMPLE I RADIOCARBON DATES
(With references from data in Tables 11 and 12)

Ref. No.	Beam No.	Sample	Numbers Museum	Lab	Date Counted	Age Years B. P.	Age A.D. Yrs.	Average Age, A.D. Years, with ± 30 half-life uncertainty included.
1.	Rm. 1, VB2	T-55		P-230	7/8/59	1362±61	597±61	
					9/3/59	1245±62	716±62	
						1304±88	655±88	655± 93
2.	Rm. 2, VB2	T-61		P-232	7/7/59	1233±65	726±65	
					8/11/59	1283±66	676±66	
	(second portion, termites not removed)			P-232	6/13/59	1295±66	664±66	
						1270±59	689±59	689±49
3.	Rm. 3, VB2	T-68		P-234	11/7/59	1282±88	677±88	
					12/5/59	1263±66	696±66	
						1272±47	687±47	687± 56
4.	L.3, c or d	T-95		P-247	7/3/59	1274±66	685±66	
	(second portion)			P-247	7/14/59	1327±66	632±66	
					8/6/59	1221±66	738±66	
						1274±39	685±39	685± 49
5.	L.3, e	T-318		P-251	6/29/59	1219±67	740±67	
					7/31/59	1181±62	778±62	
					8/7/59	1399±79	560±79	
						1265±106	694±106	694± 110
	Average age of seven samples from five beams (1-5), from data in Table 14, with ± 30 half-life uncertainty included (From statistical uncertainties alone, without ± 30 half-life uncertainty, the standard deviation of the average is ± 21 years).							= 684 ± 37
	Note: Sample No. P-229, (T-54), below, omitted from average, presumed to be from older re-used vault beam. (V. S.).							
6.	Rm. 1, VB1 (Second portion)	T-54		P-229	1/21/59	1550±66	409±66	
				P-229	7/9/59	1460±64	499±64	
					7/22/59	1401±66	558±66	
					8/8/59	1562±66	397±66	
						1494±79	465±79	465 ± 85

With P–229 excluded for this reason, the average radiocarbon age for the placement of these beams in Temple I is then A.D. 684±37. The second portion of sample P–232 (Table 10, Ref. No. 2) was run to test the danger of termite contamination. The outer parts of these beams, the portions used for radiocarbon dating, had been attacked by termites and were heavily infested with their remains. For all samples except this one, these were removed as thoroughly as was physically possible. The fact that this one measurement with termite-infested wood gave the date of A.D. 664±73 (half-life error included), a date agreeing with the average age for the five beams, indicates that the termite deposits were insignificant fractions of the total carbon contents of the beams *or* were nearly contemporaneous with the wood.

Explanation of Radiocarbon and Statistical Procedures

The calculations of the standard deviation of the average count for each beam (and for the over-all average) follow the usual statistical procedure for the analysis of random events. The symbols and the procedure (for Beam Ref. No. 1, Temple IV) are explained below.

T=Period=1000 minutes=duration of each individual count.

N=Number of 1000-minute periods, or individual sample counts.

n_t=Actual number of counts observed in each 1000-minute period (second column).

$\bar{n}_t$=Average count for the N 1000-minute periods.

n_n=Net count for each 1000-minute period; that is, the actual number of counts observed minus the background (third column).

b=Background count which consists of unwanted counts which cannot be eliminated by shielding. It is measured independently with a sample of anthracite coal, which is too old to contain detectable C^{14}. The value used to obtain each net count is an average of the background runs made before and after the Tikal measurement.

$\bar{n}_n$=Average net count for the N 1000-minute periods.

$n_n-\bar{n}_n$=The difference between the average net count and each specific 1000-minute count (fourth column).

$(n_n-\bar{n}_n)^2$=The square of the numbers in the fourth column (fifth column).

σ_n=Standard deviation of any single measurement of a set of N, an indication of the internal consistency of the measurements.

$$\sigma_n=\sqrt{\sum_1^N(n_n-\bar{n}_n)^2/(N-1)}$$

σ_t=Standard deviation of a single measurement of the distribution in n_t, due to statistical variations.

$$\sigma_t=\sqrt{\bar{n}_t}$$

σ_a=Statistical standard deviation of the average of the net count, that is, a difference (total count minus background count), the basis of the usual error figure listed for an individual radiocarbon date when N=1.

$\sigma_a=\sqrt{(\bar{n}_t+b)N/N}$ where b=average background.

We now compare the sigmas. If σ_n is less than or close to σ_t, then the fluctuations in values of single meas-

TABLE 11

TEMPLE I BEAM DATA

Date Counted	n_t (Total Count)	n_n (Net Count)	$n_n-\bar{n}_n$	$(n_n-\bar{n}_n)^2$
		Beam No. P-229		
1/21/59	35,156	26,489	-203	41209
7/9/59	37,383	26,807	+115	13225
7/22/59	37,182	27,004	+312	97344
8/8/59	37,098	26,467	-225	50625
	$\bar{n}_t$ = 36,705	$\bar{n}_n$ = 26,692	Σ = -1	Σ=202403
		Beam No. P-230		
7/8/59	37,748	27,118	+211	44521
9/3/59	37,181	27,539	+210	44100
	$\bar{n}_t$ = 37,465	$\bar{n}_n$ = 27,329	Σ = -1	Σ=88621
		Beam No. P-232		
7/7/59	38,202	27,572	+127	16129
8/11/59	38,032	27,401	- 44	1936
6/13/59	38,211	27,361	- 84	7056
	38,148	27,445	Σ = -1	Σ=25121
		Beam No. P-234		
11/7/59	37,575	27,405	- 34	1156
12/5/59	38,181	27,473	+ 34	1156
	$\bar{n}_t$ = 37,878	$\bar{n}_n$ = 27,439	Σ = 0	Σ= 2312
		Beam No. P-247		
7/3/59	38,061	27,431	- 2	4
7/14/59	37,829	27,253	-180	32400
8/6/59	38,247	27,616	+183	33489
	$\bar{n}_t$ = 38,046	$\bar{n}_n$ = 27,433	Σ = 1	Σ=65893
		Beam No. P-251		
6/29/59	38,258	27,620	+156	24336
7/31/59	38,349	27,718	+254	64516
8/7/59	37,685	27,054	-410	168100
	$\bar{n}_t$ = 38,097	$\bar{n}_n$ = 27,464	Σ = 0	Σ=256952

TABLE 12

STANDARD DEVIATIONS FOR TEMPLE I BEAMS

DERIVED FROM DATA IN TABLE 11

WITH T = 1000 AND b = 10,000

Beam No.	N	σ_n	σ_t	σ_s	Accepted Sigma/T
P-229	4	260	192	108	0.260
P-230	2	298	193	155	0.298
P-232	3	112	195	128	0.128
P-234	2	48	195	156	0.156
P-247	3	181	195	127	0.127
P-251	3	359	195	127	0.359

urements are consistent with statistical variances and there is no reason to suspect errors from other causes such as incorrect measurement, or samples of different ages. We expect to find reasonable agreement between σ_n and σ_t. However, by chance (see Beam No. 2), especially in groups of small N, it is possible for σ_n to be much less than σ_t, but we must assume that the standard deviation is σ_t because this lower value of σ_n is only accidental. If the background were disregarded, our standard deviation of the average (provided σ_n is less than or close to σ_t) would be $\sigma_t/\sqrt{N}$. However, our net radiocarbon count is the difference of two independent counts, and the variation of the background must be included. The standard deviation of the average is, therefore, σ_s unless σ_n is significantly larger than σ_t in which case the tolerance used is σ_n. The appropriate sigma is then divided by T to give the counting-rate tolerance for the age calculations.

Example: Beam No. 1 (P–235, Temple IV)
where N=5, and b=10,000.

Date Counted	n_i	n_n	$n_n-\bar{n}_n$	$(n_n-\bar{n}_n)^2$
2/11/59	37,102	27,699	−113	12769
2/14/59	37,214	27,950	+138	19044
2/17/59	37,206	27,942	+130	16900
5/27/59	38,440	27,768	− 44	1936
6/ 1/59	38,414	27,703	−109	11811
	$\bar{n}_i$=37,675	$\bar{n}_n$=27,812	Σ=+ 2*	Σ=45630

* Note: This sum is not always zero because figures have been rounded off to nearest whole numbers.

$\sigma_n=\sqrt{45{,}630/4}=109$

$\sigma_t=\sqrt{37{,}675}=194$

$\sigma_s=\sqrt{(37{,}675+10{,}000)\,5/5}=106$

In this case, σ_n is less than σ_t so that non-statistical or non-systematic errors can be ruled out. Therefore, we use σ_n for our standard deviation of the average, and the value to be used for age calculation is σ_n/T which is 0.106 c/m.

Data for the ten beams of Temple IV are presented in Table 2 and a summary of the resultant sigmas in Table 3 where the appropriate sigmas for age calculations are underlined.

It can be seen in Table 3 that for Beams 7 and 8, σ_n is significantly greater than σ_t. This might indicate non-statistical errors. Therefore, we apply the χ^2 test, which is another means of ascertaining whether the fluctuations

TABLE 13

DATA FOR χ^2 TEST FOR TEMPLE I BEAMS

Sample	χ^2	n - 1	$P(\chi^2)$
P-229	7.58	3	0.0575
P-230	3.24	1	0.0755
P-232	0.92	2	0.639
P-234	0.084	1	0.776
P-247	2.40	2	0.316
P-251	9.36	2	0.0095

are purely statistical; that is, consistent with Poisson's Law. From the data in Table 2, χ^2 is computed for each beam.

$$\chi^2=1/\bar{n}_n\sum_1^N(n_n-\bar{n}_n)^2$$

With these values of χ^2 and the number of degrees of freedom for each beam, which in this case is N–1, we find values of $P(\chi^2)$ in Segrè (1959, Table 5). Values of χ^2 which indicate a probability corresponding to $P(\chi^2)\geq 0.1$ are acceptable, that is, are consistent with Poisson's Law.

These values are shown in Table 4 where it can be seen that all beams except No. 8 pass the test. The average age of Beam No. 8 (A.D. 766) is not out of line, however, so that we can attribute the internal inconsistency of the individual measurements of this one beam to statistical fluctuations.

The main purpose in presenting Tables 2 to 4 inclusive is to illustrate our method of data analysis. We now come to the first important question — namely, whether or not the ten beams are contemporaneous with each other. To answer this, we proceed with an over-all analysis of our 33 measurements as shown in Table 5. (For this we have substituted $1/\bar{n}_i$ for $1/\bar{n}_n$ in the χ^2 formula.)

We find from Table 5 that:

σ_n=185

σ_t=194

σ_s=38

χ^2=29.17, N–1=32

$P(\chi^2)$=0.5

We observe that σ_n is less than σ_t and that $P(\chi^2)$ is much greater than 0.1. Therefore, it is safe to assume that non-statistical errors, which in this case include possible significant age differences among the beams, can be ruled out. In other words, these statistical tests suggest strongly that the ten beams are contemporaneous. Also, because of this internal consistency, the standard deviation of the over-all average, σ_s, may be used for the over-all average calculation. This over-all average is, in effect, the weighted average of the ten beams.

An identification of the wood of these beams was made by George K. Brizicky (S. J. Record Memorial Collection, School of Forestry, Yale University, June 19, 1959), and we wish to express our gratitude to him and to William L. Stern for these careful analyses. Brizicky identified nine of the Temple IV beams (no material was available for Beam No. 4, P–238) as *Achras* (*Manilcara*) sp. probably *zapota* L. (*Manilcara zapotilla*, Jacq.) Gilly, a member of the Sapotaceae family.

It should also be mentioned that the outer surfaces of these ten beams, the portions used for radiocarbon dating, were riddled with termite holes which were filled with termite deposits. They were cleaned physically as thoroughly as possible before processing, and as shown by results for sample P–232 (Temple I), are believed to be insignificant as contamination factors.

It is noted in Table 13 that three Temple I beams (P–229, P–230, and P–251) do not pass the χ^2 test. Except for P–229, the average age values are not extreme so that we may attribute this lack of internal consistency for P–230 and P–251 to apparatus uncertainties during this measurement period. The test reveals that the accuracy of our measurement of P–229 is less than that of others; nevertheless, the significantly lower age value, as shown in Figure 4, indicates that it was an older re-used beam.

This supposition is confirmed by the data in Table 14. If P–229 is included, we find

σ_n=328
σ_t=194
σ_s= 53
χ^2=62.87, P(χ^2)<0.01

We note that σ_n is greater than σ_t and that the measurements do not pass the χ^2 test. If P–229 is excluded, we find

σ_n=205
σ_t=195
σ_s= 61
χ^2=18.35, P(χ^2)=0.17

The fact that σ_n is now close to σ_t and P(χ^2) is greater than 0.10 when P–229 is excluded eliminates doubts that P–229 is not contemporaneous with the other five beams.

In addition to the counting runs listed in the tables, 34 were rejected for various laboratory reasons. These are summarized below.

Counting runs	*Temple IV*	*Temple I*
Total number	53	30
Acceptable	33	16
Rejected	20	14

Reasons for rejected counting runs	*Numbers*
CO_2 (counting gas) not pure	10
Radon in counter filling trap	3
Electronic circuit breakdowns	4
Failure of Geiger counters in anti-coincidence ring	5
Erroneously high counting rates due to cosmic ray showers, fallout, or extraneous noise pulses	12
TOTAL	34

These runs were rejected on the basis of failures detected by the routine laboratory checks which include neutron and other counter monitors for the measurement of fluctuations in background radioactivity.

THE CORRELATION PROBLEM

In considering in detail the meaning of our radiocarbon dates relative to the correlation problem we shall not attempt to explain how it comes about that a final decision has not been reached among various proposed solutions. It must be remembered, however, that they are all *day-for-day correlations* founded on various types of evidence. A radiocarbon spread of years may in principle render untenable some or all proposed day-for-day correlations, or impose limits for possible new ones. If one is satisfied that he has a list which includes the correct solution, and also that radiocarbon results eliminate all but one of them, logically he will accept the latter as correct. Therefore, in presenting our case, we need a fairly uncritical list designed to include all known correlations which may possibly have present-day responsible proponents, or which might attract supporters in the future.

After publication of the Kulp and Libby radiocarbon findings, such a list was prepared (Satterthwaite 1956). We repeat it in Table 15, with the addition of a new correlation by William B. Dinsmoor. Though as yet unpublished, it is included with his permission and that of the Wenner-Gren Foundation.

We do not repeat a full discussion of the labels used for the correlations in our checklist, and will confine ourselves mainly to the column of letter-designations. We shall use the term Correlation A to include the three variants A1–A3, and Correlation B to include the four variants B1–B4. Correlation C of the present list is not the extremely early Correlation C of Spinden 1930, but A3 and B4 correspond to his Correlations A and B.

TABLE 14

TEMPLE I DATA FOR OVER-ALL AVERAGE AGE CALCULATIONS AND CONTEMPORANEOUS ANALYSIS

No.	Date Counted	n_s	n_n	$n_n-\bar{n}_n$ with P–229	$n_n-\bar{n}_n$ without P–229	$(n_n-\bar{n}_n)^2$ with P–229	$(n_n-\bar{n}_n)^2$ without P–229
P–229	1/21/59	35,196	26,489	-765		585,225	
	7/9/59	37,383	26,807	-447		199,809	
	7/22/59	37,182	27,004	-250		62,500	
	8/8/59	37,098	26,467	-787		619,369	
P–230	7/8/59	37,748	27,110	+356	+310	126,496	96,100
	9/3/59	37,181	27,339	+285	+111	81,225	12,321
P–232	7/7/59	38,202	27,572	+388	+164	101,124	26,736
	8/11/59	38,032	27,405	+167	- 27	27,889	729
	6/13/59	38,211	27,361	+107	- 67	11,449	4,489
P–234	11/7/59	37,975	27,409	+151	- 23	22,801	529
	12/5/59	38,181	27,473	+219	+ 43	47,961	1,849
P–247	7/3/59	38,061	27,431	+177	+ 3	31,329	9
	7/14/59	37,829	27,253	- 1	-175	1	30,625
	8/6/59	38,247	27,616	+363	+188	131,844	35,344
P–251	6/29/59	38,258	27,620	+366	+192	133,956	36,864
	7/31/59	38,349	27,718	+464	+290	215,296	84,100
	8/7/59	37,685	27,094	-200	-374	40,000	139,876
		$\bar{n}_s$ = 37,669	$\bar{n}_n$ = 27,254	Σ = + 10	Σ = - 1	Σ = 1,713,196	Σ = 503,347

Note: The omission from the over-all average calculations of P-229 necessarily change the values of $\bar{n}_s$, $\bar{n}_n$, $n_n-\bar{n}_n$, and $(n_n-\bar{n}_n)^2$.

P-229 included:	P-229 omitted:
$\bar{n}_s$ = 37,669	$\bar{n}_s$ = 37,966
$\bar{n}_n$ = 27,254	$\bar{n}_n$ = 27,420
$\Sigma(n_n-\bar{n}_n)$ = + 10	$\Sigma(n_n-\bar{n}_n)$ = - 3
$\Sigma(n_n-\bar{n}_n)^2$ = 1,713,196	$\Sigma(n_n-\bar{n}_n)^2$ = 503,347

Disregarding variants, Correlations A, B, C, and D place a given Long Count date at increasingly later positions in actual time, the intervals being about 260 years. Correlations Y and X are lettered separately to remind the reader that they do not use this 260-year yardstick. Astronomical controls have been dominant in their derivation.

The count of Julian Day Numbers from a base at January 1, 1413 B.C., is the best common measure for correlating two calendar systems. The Correlation Constants of our checklist are the Julian Day Numbers for the Christian civil calendar dates at which the respective correlations place the base-date of the Long Count (13.0.0.0.0 4 Ahau 8 Cumku). One may convert any Long Count date (a number) to decimal form, add it to the correlation constant, and obtain the Julian Day Number for that Long Count date. With suitable tables this is readily converted to a civil calendar date.

The Christian year thus found may be called the correlation date of the Long Count date, according to the particular correlation used. At the right of the checklist (Table 15) we give the correlation dates for 9.15.10.0.0, the dedicatory Long Count date on the lintel from Structure 10. For any other Long Count date we should get a different list of correlation dates, but they would show the same spacing in time. So we may think of Correlation B as intermediate, those earlier and later on our list being early and late.

The radiocarbon result of Kulp (A.D. 481± 120 for the Structure 10 lintel) revived interest in the early Correlation A, or at least in the A3 Spinden variant. The early Dinsmoor Correlation Y is new. Thompson stood firm for Correlation B4, but in 1950 shifted to B2 in response to new evidence. Lothrop has recently used new evidence to revive interest in Correlation X and the Vaillant correlation, of which Correlation C is a more precise version (Lothrop 1952: 111–2). So, if we test Correlations A, Y, B, X, and C against our radiocarbon dates we shall not be flogging dead horses. We shall, however, consider Correlation D, which is an extremely late one, to have been eliminated previously by the findings of Kulp and Libby.

TABLE 15

CHECKLIST OF MAYA-CHRISTIAN DATE CORRELATIONS

"Katun 13 Ahau" near AD 1540 at:	Label		Cor. Constant	9.15.10.0.0 at:
12. 9. 0. 0. 0	A1	Makemson	489,138	AD 480(Dec 26)
" " " " "	A2	Modified Spinden	489,383	AD 481(Aug 28)
" " " " "	A3	Spinden	489,384	AD 481(Aug 29)
	Y	Dinsmoor	497,879	AD 504(Dec 1)
11.16. 0. 0. 0	B1	Goodman, Martinez H.	584,281	AD 741(June 22)
" " " " "	B2	Modified Thompson 2	584,283	AD 741(June 24)
" " " " "	B3	Modified Thompson 1	584,284	AD 741(June 25)
" " " " "	B4	Thompson	584,285	AD 741(June 26)
	X	Kreichgauer	626,927	AD 858(Mar 26)
11. 3. 0. 0. 0	C	Escalona Ramos	679,108	AD1001(Feb 4)
10.10. 0. 0. 0	D	"Weitzel"	774,078	AD1261(Feb 9)

Note. The "Correlation Constant" is the Julian Day Number for the Christian date in which the correlation places 13. 0. 0. 0. 0 4 Ahau 8 Cumku, the Maya base from which Long Count dates such as 9. 15. 10. 0. 0 are counted. Christian dates are calculated in "Old Style" Julian Calendar.

Dedicatory Dates of the Lintels

In the course of his work for the Tikal Project, Coe has greatly extended the photographic record of the carved lintels, including those of Structure 10 and Temple I. Heretofore there has been no such record of the two in situ beams of Lintel 2 of this temple. As yet, the photographs have not been published; however they have been used by Satterthwaite in an Appendix to the report of Coe and Shook on the lintels, now in press. In that Appendix the inscriptions on the lintels are reviewed in detail, and we anticipate here to the minimum extent necessary.

The dates on the five lintels are in Table 16. Long Count dates and one Secondary Series are in parentheses to indicate that they are supplied, not recorded.

Although substantial portions of several designs on these lintels are missing, it is highly improbable that any dates are unaccounted for. It is clear that a Calendar Round date in the month Yaxkin opened a seven-bloc panel on Lintel 2 of Temple I. A period-ending glyph could have followed, but the block is completely destroyed. There was no Secondary Series, which rather suggests that if this was a non-tun-end date, it was not far distant from the opening tun-end date on Lintel 3. A short Secondary Series was omitted on that lintel.

The supplied Long Count positions are mandatory by inspection at Temple IV and Structure 10, and are as given in Morley (1937–38, Vol. 1: 359, 361; 342). Those on Lintel 3 of Temple I are one Calendar Round period (52 years) earlier than Morley's positions. Beyer (1943) showed that Morley was wrong in assigning the beams involved to Temple IV, and Coe and Shook (in press) prove they are from

TABLE 16. DEDICATORY DATES ON LINTELS

Temple IV, Lintel 2

(9.15.10. 0. 0) 3 Ahau 3 Mol, ½-katun
2.11.12
(9.15.12.11.12) 6 Eb 0 Pop
1
(9.15.12.11.13) 7 Ben 1 Pop
3. 2. 7
(9.15.15.14. 0) 3 Ahau 13 Uo

Temple I, Lintel 2

(?. ?. ?. ?. ?) ? ? ? Yaxkin

Temple IV, Lintel 3

(9.15.10. 0. 0) 3 Ahau 3 Mol, ½-katun
2. 2. 2
(9.15.12. 2. 2) 11 Ik 15 Chen
1
(9.15.12. 2. 3) 12 Akbal 16 Chen
3.(0. 0)
(9.15.15. 2. 3) 13 Akbal 1 Chen

Temple I, Lintel 3

(9.13. 3. 0. 0) 9 Ahau 13 Pop
7.18
(9.13. 3. 7.18) 11 Eznab 11 Chen
(2. 0)
(9.13. 3. 9.18) 12 Eznab 11 Zac
–13.10. 2
(9.12. 9.17.16) 5 Cib 14 Zotz

Structure 10, Lintel

(9.15.10.0.0) 3 Ahau 3 Mol, ½-period

Lintel 3 of Temple I. There is no recognized declaration of period-end position, but Beyer, by brilliant analysis involving Stela 29 of Naranjo, showed that the 9 Ahau 13 Pop date belongs at 9.13.3.0.0, a tun end. Accceptance of Beyer's analysis necessitates the Long Count positions given for the other three dates of Lintel 3.

Maya texts normally record a date which is classed as dedicatory, commemorative, or contemporaneous. All of these terms mean that the date has been inferred to be approximately contemporaneous with the carving and erection of the date-bearing monument itself. Other dates may or may not be recorded. For maximum precision we should compare our radiocarbon dates with correlation dates derived from dedicatory dates. We have set down all recorded dates in the two temples because of difficulty in selecting particular dedicatory dates which surely could not be challenged. We do not make such selections, but undertake to define acceptable limits for the dedicatory dates at each temple. These require a little explanation.

Rules for according dedicatory status to recorded Maya dates are discussed rather briefly in Thompson (1950: 154–6) and in Proskouriakoff (1950: 9–10). Thompson makes the important point that no rules are foolproof — there are exceptional cases. Two criteria are usually valid for Late Classic period texts, including all stone monuments of that period at Tikal:

1. The recorded dedicatory date is at a tun-end (and most commonly at a katun-end or at the end of a 5-tun division of a katun).
2. The dedicatory date is the only date recorded or, if not, it is the *latest* date recorded.

Morley's dedicatory classification of the single date inscribed on the lintel of Structure 10, 9.15.10.0.0, conforms to both these rules. But at Temple IV the same date, a tun-end as required by Rule 1, is followed on each lintel by three non-tun-end dates, the latest of which are more than 5 tuns later. Rule 2 does not apply. In effect Morley's solution assumed that a dedicatory date which would follow Rule 2 was meant to be understood, and was not actually recorded. He suggests 9.16.0.0.0 (??) as the

probable dedicatory date of Temple IV. This is at the end of the current katun, during which the recorded dates fell. A reason for not allowing for some still later non-recorded katun-end is provided by the local pattern on stelae of the late period. On these monuments the dedicatory tun-end date is never later than the end of the katun in which fell the latest non-tun-ending date. This is a common pattern elsewhere.

The generally valid dedicatory date rules imply a Maya habit of looking to the past when recording dates other than the dedicatory ones. Therefore, we need not consider the theoretically possible suppression of a dedicatory tun-end date *earlier* than the recorded 9.15.10.0.0 date. If the dedicatory date was not in fact omitted, the latter is a safe early limit for it.

The situation at Temple I is somewhat different. Beyer implied that the single date at a tun-end on Lintel 3 (9.13.3.0.0) was the dedicatory date, and a better case could be made for it than could be done for the recorded 9.15.10.0.0 at Temple IV. But again there must be an exception to the general rules, and in view of the Temple IV situation it is perhaps safest to allow for the possibility of a non-recorded dedicatory date, choosing the end of the current katun as the late limit. It may be objected that a dedicatory tun-end, following the rules, may have been recorded on the damaged Lintel 2. This is highly unlikely. The time distance is more than two and a quarter katuns forward from the latest date on Lintel 3 to the earliest tun-end in Yaxkin (9.15.11.0.0).

We conclude that a ten-tun spread for dedicatory date uncertainty for Temple IV and a 17-tun spread for Temple I are not likely to be challenged, though it might possibly be argued that the latter should be extended in the late direction. Opinions may differ as to precise dedicatory dates. For our purposes we may consider the 360-day tuns as complete years.

Using the correlation constants of our checklist (Table 15) we obtain limits for correlation dates corresponding to dedicatory dates (Table 17).

Table 17. Limits for Correlation Dates Corresponding to Dedicatory Dates

Dedicatory Dates	Correlation Dates (A.D. years) A	Y	B	X	C
Temple I:					
Early limit: 9.13. 3. 0. 0	435	458	695	812	955
Late limit: 9.14. 0. 0. 0	452	475	712	829	972
Structure 10:					
9.15.10. 0. 0	481	504	741	858	1001
Temple IV:					
Early limit: 9.15.10. 0. 0	481	504	741	858	1001
Late limit: 9.16. 0. 0. 0	491	514	751	868	1011

Comparisons of the Radiocarbon and Correlation Dates

Our radiocarbon results for Temples IV and I are graphed in Figures 1 and 4, respectively. For Temple IV we have calculated averages for ten individual beams and the general average for all ten. For Temple I we have calculated averages for six individual beams, and the general average for five of them. We have explained why our radiocarbon date for a duplicate of one of Libby's samples was not included in the general average for Temple IV, and why Beam Ref. No. 6 from Temple I was excluded. The general averages for the two temples, with standard deviations represented by vertical thick bars in Figures 1 and 4, are:

Temple IV (ten beams) — A.D. 746±34
(limits are A.D. 712–780)

Temple I (five beams) — A.D. 684±37
(limits are A.D. 647–721)

We have concluded that for Temple IV the Maya dedicatory date was not outside of the Long Count limits 9.15.10.0.0–9.16.0.0.0, a "dedicatory-date uncertainty spread" of about ten years, and, that for Temple I, a 17-year spread from 9.13.3.0.0. to 9.14.0.0.0 is all that need be considered. Correlation dates for these early and late dedicatory date limits have been supplied, according to Correlations A, Y, B, X, and C of Table 15, as alternative possibilities. These limits for dedicatory dates in terms of Christian years are represented in Figures 1 and 4 by "hollow" horizontal bars. For each correlation the lower side of the bar is at the year of the early limit, and the upper side is at the year of the late limit. The two pertinent years are noted at the right of each bar.

If one of the correlations used is correct, we expect both sides of its bar to pass through the vertical thick black bar representing the standard deviation or radiocarbon "spread" for the general average, or at least not far above or below it. Put differently, the dedicatory date spread of a correct correlation ought to lie

within the standard deviation, or perhaps within a moderate expansion of it. To allow for the latter possibility thin-line extensions mark off such expansions to twice the standard deviation spreads represented by the thick vertical bars.

A glance at Figures 1 and 4 shows that any variant of Correlation B passes this test for both temples, with the early and late dedicatory date limits confined within the respective standard deviation spreads. For Temple I both limits are later than the central year of the radiocarbon spread, but the late limit is nine years earlier than the late radiocarbon limit if we use standard deviation only. It is doubtless a coincidence that in the case of the Temple IV dates the center of our dedicatory date spread is, in this correlation, precisely at the center of the radiocarbon spread (A.D. 746). The significant thing is that for the two temples no expansions of the radiocarbon standard deviation spreads are required to accommodate Correlation B equivalents of dedicatory date limits based on recorded Maya dates.

In strong contrast the standard deviation spreads would have to be expanded by statistically unbelievable amounts to reach the corresponding dedicatory date equivalents according to any of the other correlations being considered. For example, Correlation X (Kreichgauer) is closest to Correlation B, and gives A.D. 868 for the upper dedicatory date limit at Temple IV. In order to accommodate it the standard deviation spread would have to be expanded four times to give an upper radiocarbon limit of A.D. 882. Based on statistical considerations alone, the chances of such an expansion being realistic are no better than one in 10,000. Allowing for absolute age uncertainty also, the chances are not better than one in 22. Much greater expansions would be required to reach the dedicatory date limits according to the early variants of Correlation A of Spinden and Makemson, and the early Correlation Y of Dinsmoor, or the late Correlation C of Escalona Ramos and Vaillant, as noted in discussing radiocarbon results for Temple IV beams. Thus these appear to be even more effectively ruled out.

We believe that our test is valid because of the large numbers of samples used, the care in selecting samples to keep post-sample growth error to a minimum, and because our counter calibration has been related to true ages (see discussion of tree-ring controls). We conclude that some variant of the 11–16 correlation long advocated by Thompson is the only one on our checklist (Table 15) that can be correct. The variant here labeled B2 (Modified Thompson 2) has very recently been discussed by Thompson (1958) and is the one most consonant with combined historical evidence and astronomical controls.

ADDENDUM

Since this paper went to press a new early "astronomical" correlation has been proposed, with 482,699 as the correlation constant or "Ahau equation" (Smiley 1960). We suggest labeling it "Correlation Z," and adding it at the beginning of our checklist (Table 15). It places Maya dates somewhat more than 17 years earlier than the earliest (Makemson) variant of Correlation A, failing to pass our proposed radiocarbon test by a wider margin than any other represented in our Figures 1 and 4.

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THE DRY PRONG SITE, EAST CENTRAL ARIZONA*

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ABSTRACT

A series of large structures termed great kivas has been excavated at Point of Pines, Arizona. To add to the sequence of these kivas a site was excavated in 1959 on one of the upper tributaries of Eagle Creek, 16 miles northeast of Point of Pines. The site complex included a great kiva and five attached rooms, a U-shaped masonry pueblo, scattered storage units, trash deposits, a reservoir, and agricultural terraces. The kiva was rectangular with an encircling bench, a stepped entrance, two possible floor resonators, and a post pattern suggesting a polygonal roof support. The ceramic content of the site places it late in the Reserve phase which is dated from A.D. 1000 to 1150.

This particular kiva type appeared during late Three Circle phase and had a distribution centered in the upper San Francisco and Blue River valleys. The antecedents for the structure seem to lie in the general Mogollon great kiva tradition. The surrounding areas were examined for possible contributions to the complex; ceramic evidence of contact was present but no definite source for the introduction was found. The presence of a number of Anasazi traits plus the direction of Reserve phase cultural change suggests a northern source for this kiva form.

ARCHAEOLOGICAL research at Point of Pines, Arizona, has provided an impressive amount of evidence for the presence of a long tradition of specialized religious structures. One class of these buildings, termed great kivas, differs from the rooms inferred as secular units in the combination of certain architectural features and in absolute size. A length or diameter of over 30 feet or 9 m. would mark the minimum size of these kivas. These buildings are also separated from "small" kivas in size; some floor features and architectural elements are shared between the two types. Evidence for the air circulating device of a vent, deflector, hearth, and hatch is ordinarily present in small kivas and is infrequently found in great kivas. The entrance patterns of the latter form seem to have made this specialized air-clearing device unnecessary. Floor drums, sipapus, benches, recesses, wall or floor niches, and specialized roof supports, either as a part of the wall construction or freestanding, are usual small kiva features. Of these elements, sipapus and niches are usually not found in great kivas and seldom are all these features found in combination within a single structure. Some situations, such as a subterranean location or a particular spatial relationship to the dwelling units, may provide additional validity in the description of a specific kiva. It seems particularly fruitless to attempt an all-inclusive definition of the great kiva here. Two sources which may be consulted with profit in this search for a definition are Smiley (1952) and Smith (1952). Kiva description could be classed with a belief in extra-sensory perception. Few people would completely deny its presence, but no one would want to accept all the proposed examples of it. Each kiva stands or falls on the complex of internal features, the outline and the relationship of the floor to the surface of the ground, and the location of the unit within the village.

The establishment of a complete sequence of great kivas is one of the major challenges offered by the archaeology of the Point of Pines region. Wheat (1954) described two such structures from the Circle Prairie phase and dated them in the early centuries of the Christian era. Breternitz (1959) excavated and reported a great kiva from Arizona W:10:111, a village of the Nantack phase, which is assigned to the 10th century. The kivas from the Crooked Ridge Village were described as ovoid and squarish; the Nantack Village kiva was rectangular with rounded corners. These kivas were subterranean, lacked masonry, and had a roofing pattern which probably gave the external aspect a domed effect which differed little from the contemporary pit houses except in sheer size. Internal features and structural elements could be duplicated in the houses of these phases with the exception of floor resonators or footdrums, elaborated fire pits, specialized pits in the floor or bench, and differing entrance patterns. Houses were grouped around these kivas in an open manner, probably as a result of the spatial requirements of pit house construction. Other than a general central location, there was none of the enclosing effect which was demonstrated in later phases by the eventual inclusion of the kiva within the room block. While these buildings may well have been the centers of village religious and secular group activity, the net effect of a nucleated village pattern is not as striking as in many masonry sites which enclose a great kiva.

At the Turkey Creek Ruin, Arizona W:10:-78, a great kiva has been excavated which is

* Contributions to Point of Pines Archaeology, No. 15.

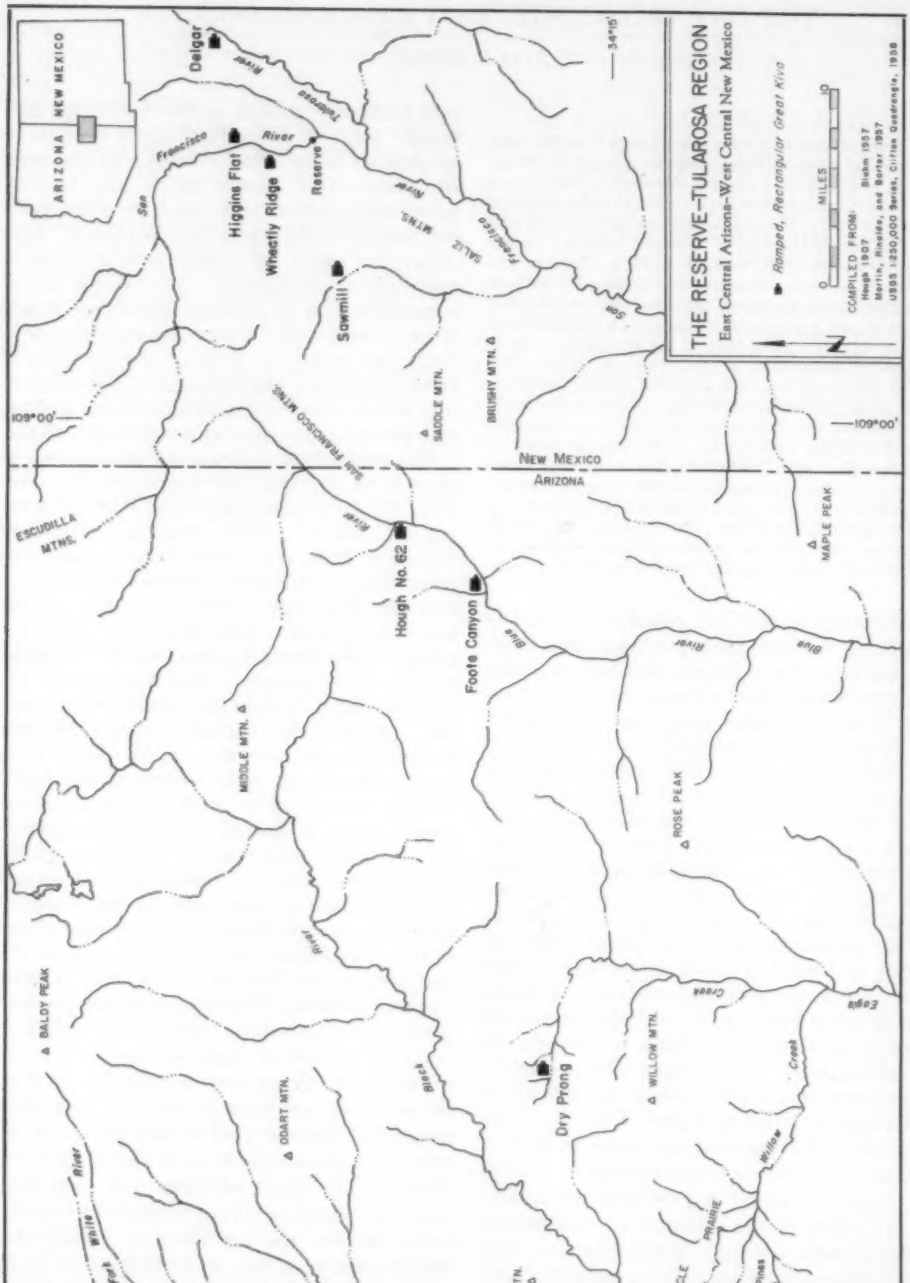

Fig. 1. Map of the Reserve-Tularosa phase region showing the location of some rectangular, ramped great kivas.

presently unreported. It was rectangular, had rows of posts in line with the long dimension, and was sunken only slightly below the surface of the ground. The outlines of the kiva were marked by a masonry wall; an unformalized opening served as the entrance. The total floor space could not be matched by the largest rooms, the fire area was not specially enclosed, and the structure was completely included within the room block. Two seasons excavation in over 300 rooms have provided ample evidence for the assignment of the ruin to the early Tularosa phase, A.D. 1150–1200.

Excavation at Arizona W:10:50, the Point of Pines Ruin, produced a great kiva incorporated within the pueblo. This kiva, which received its main use during Canyon Creek phase (Gerald 1958), was very similar to the one found at the Turkey Creek Ruin. It differed in several ways. Running from the post supports to the large, stone-enclosed hearth were rows of stone filled trenches. These trenches may have been used as resonators when covered with suitable material but the stone packing suggests some more esoteric function. The entrance led out through the room block in an angled path and formed one of the very few passages or alleyways through the pueblo.

Prior to 1958 no great kiva had been excavated within the Reserve phase at Point of Pines, although the original survey made by E. W. Haury and E. B. Sayles had located such a site in 1945, Arizona W:6:5, on the Dry Prong of Eagle Creek. The exploration of this ruin provided one of the final links in the evidence for a sequence of great kivas which spans nearly 1500 years.

It should be emphasized that the progression of cultural events at Point of Pines did not operate in a vacuum, and that present evidence indicates that the history of the region was closely bound up with that of neighboring ones. Particularly has the Reserve, New Mexico, region followed a similar pattern, one which finds its greatest expression at Point of Pines in the Reserve and Tularosa phases, the period from A.D. 1000 to 1265. The relationship on earlier time horizons has been well summarized by Wheat (1954, 1955) and will not be repeated here.

During the terminal portion of the Chicago Natural History Museum's excavations in the Reserve, New Mexico, region a specific form of the great kiva was investigated and two such structures reported (Bluhm 1957; Martin, Rinaldo, and Barter 1957). These kivas were assigned to both Reserve and Tularosa phases. The kivas were rectangular and semi-subterranean with a masonry facing of the interior which was continued as a border for the eastern ramp entrance. Floor features included a simple pattern of roof support, floor trenches between some post holes, and fire areas which were simple burned patches on the floor in line with the entrance.

This type of kiva had a restricted distribution in the Southwest, and the form of the structures and the cultural associations of the people who used them present a number of problems. The periods in which these kivas flourished were marked by a rapid change in material culture content and present a special problem in understanding the trading contacts and cultural interchange among the inhabitants of the upper tributaries of the Gila River. Contact was prominent on an inter-regional level and there is much evidence of a widening of horizons with the use of objects and ideas, particularly from the north.

Several aspects of the historical and cultural importance of this architectural form seem most pressing. The geographical range, the time of introduction, and the course of diffusion of the concept of this particular kiva type can be charted, if somewhat imperfectly. The cultural groups, determined by archaeological systems, which participated in the spread and use of the rectangular, ramped great kiva can also be described. As can be expected, the excavation of the Dry Prong kiva shed light on some of these problems, but hardly solved them all.

CULTURAL ECOLOGY

The Dry Prong site is located on one of the upper tributaries of the water course of this name; the present-day arroyo is one of the intermittently flowing tributaries of Eagle Creek. This stream flows to the south, ultimately reaching the Gila River. The site lies approximately one-quarter of the distance between Point of Pines, Arizona, and Reserve, New Mexico. It is 16 miles airline (Fig. 1) to the site from Point of Pines and 49 miles from Dry Prong to Reserve. Great kivas of this type are present in the Blue River drainage (Hough 1907: 53); 25 miles airline separate the Dry Prong site from the Foote Canyon pueblo cluster (Rinaldo 1959) which includes a kiva of

this type. It is only 17 miles further northeast to the Sawmill site (Bluhm 1957) from the Foote Canyon site; the rectangular great kivas at Higgins Flat pueblo and Wheatley Ridge lie only a few miles farther.

On the divide between Black River and the Dry Prong of Eagle Creek is an area of broken country reaching elevations of over 9,000 feet. The vicinity of the site is dominated by two east-west trending ridges, the northernmost of which marks the edge of the high country of the White Mountains. The southern ridge separates the Dry and Middle prongs of Eagle Creek.

The prevalent tree cover is ponderosa pine; the best stands are found on the most level ground. On the sloping sides of the ridges, oak and alligator-bark juniper are present in mixed stands. The common juniper has invaded grassy areas but has not provided serious competition with the taller trees. Pinyon is common in mixed stands and seedlings are encroaching upon stands of oak, many of which are diseased and dying. The general impression given by the tree cover is that of an open ponderosa forest infiltrated by oak and juniper, with the heaviest concentrations of vegetation on the northern sides of the ridges, with the southern slopes open and dominated by grass and shrubs.

The broken relief of the terrain, coupled with the intersection of many types of vegetative cover, make the area a superb game habitat. Heavy populations of mule deer and a few white-tailed deer range here during the entire year, with some seasonal elevation shift upward during the summer months. The recently reintroduced elk, which replaced the native elk exterminated by white pressure, winter in the region, moving down from their summer range in the higher reaches of the White Mountains to the north. This pattern was undoubtedly followed by the native elk populations in the past. Turkeys abound, still ranging in flocks of over 50; ducks of several species were seen during the field season and would be augmented during the migratory seasons. The Gambel's quail and the javelina occur in the region, but may represent recent extensions from their more usual arid southern range. The Abert's squirrel and two species of rabbit are common. The last mentioned forms are so unsophisticated that they may be taken, as my workmen did, by a thrown stone. Predators such as lion, bear, coyote, bobcat, and at least one variety of fox are present today in populations large enough that individuals, and not merely tracks, were seen. With the exception of minor changes in the ranges of these animals which would have been influenced by a heavier human population residing in the region, there is no reason to suspect that the faunal population was less adequate during occupation of the site.

A complete catalogue of the present-day vegetational possibilities of the area was not made but the following more obvious species are now available and should provide a minimum inventory. Walnuts and pinyon trees could, with some industry, be utilized for their nuts, although the erratic crops of the latter species are well known. Yucca, mescal, and prickly pear are present and were probably included in the aboriginal diet. Various grasses with small seed heads and some berry producing shrubs would have been equally useful in season. The native grape may also have provided an occasional harvest. However, in common with the majority of the prehistoric people of the Southwest, the mainstay was corn, with the inference that the remainder of the triumvirate, beans and some members of the squash group, was also present. The aboriginal economic pattern could not be proved from the non-artifactual material found and must be projected from the tool assemblage and evidence from other sites.

Sites are located close to water sources, most of which are not adequate today to supply any significant population, as the contemporary settlement dispersal of the Apache would indicate. The present-day water problem has been met by the San Carlos tribe through the construction of cattle tanks which impound large quantities of run-off water. With the exception of these recent additions to the water supply, occasional small springs are the only sources of year-round water. None of these features has attracted permanent Apache settlements. The location of aboriginal sites along the various small and currently dry tributary streams of Dry Prong Creek would suggest that during this occupation the stream may have run, or that during most of the year adequate water was available.

The presence of a reservoir near the site described here is evidence that water storage was one of the aboriginal concerns in the alteration of the run-off pattern. See Wheat (1952) for a

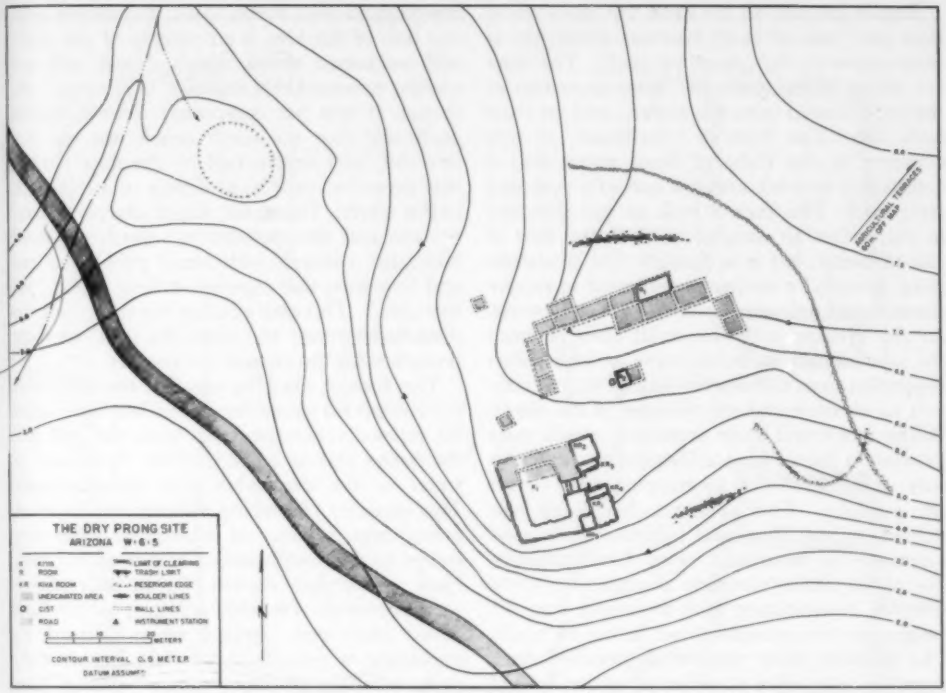

FIG. 2. Map of the Dry Prong site, Arizona W:6:5.

discussion of this type of water source in the Point of Pines region.

Several small sites of the same phase as the Dry Prong site are present in the area; an intensive survey of the region has not been made nor has the total settlement pattern been determined. Earlier or later sites were not, however, found in the immediate vicinity. It would appear that small settlements were spread up and down the creek with the inhabitants utilizing the great kiva at Dry Prong. The kiva undoubtedly formed a unifying feature for the local pueblos. As a further generalization, the sites are usually found on the tips of slightly elevated ridges or mesas adjacent to the watercourses, leaving the majority of the flat-topped mesas and valley bottoms open for agricultural exploitation.

VILLAGE PATTERN

The site is located on the tip of an extension at the southwestern edge of a low and gently south-sloping mesa nearly a quarter of a mile north of Dry Prong Creek. At the extreme end of the spur is the great kiva with the entrance leading to the east. Just north and east (Fig. 2) of the kiva is the room block, roughly U-shaped, with the opening to the south. A small trash mound lies directly south of the eastern edge of the pueblo. There are several small, isolated single or double room structures scattered over the area between the kiva and the pueblo. Just west of the mesa there is an intermittent stream which drains a small basin lying north of the site. Northwest of the ruin, in the small valley, is a reservoir which is connected to the main channel by a small diversion ditch.

The mesa surface is sparsely covered by basalt boulders. The plaza area was cleared of these stones, probably both as a convenience for walking and through the use of this rock in construction. There is a definite line where the *malpais* starts at the eastern edge of the plaza. Rows of piled rock are present at the northern and southern edges of the plaza. There appears to be enough stone in these locations to construct a wall of a few courses, but testing did not confirm this and the stone may represent spoil from construction or clearing.

East of the site on the mesa top there are at least four lines of basalt boulders which run at right angles to the prevailing grade. The lines are about 10 m. apart and seem to consist of the rock cleared from the surface upslope from each line. This form of "checkdam" is very common in the Point of Pines region and is considered to mark areas of specially prepared farm land. The lines of rock are not sufficient in themselves to completely block the flow of run-off water, but it is thought that this damming provided a similar impediment to erosive damage and soil creep as does contour plowing. At the present, with the small plots between the rows of rock no more amply endowed with vegetation than the unmodified areas, it is difficult to visualize the effectiveness of the dams. When crops and their attendant weeds were growing in these "terraces" they were undoubtedly quite successful in trapping what water was available. They appear to have been considered, by the aboriginal inhabitants, as good insurance for securing a crop. Unfortunately, due to the nearly complete absence of cultural material in association with these rock lines, an assignment to a specific phase cannot be made. The problem must then be approached on a negative basis; since no other ruins are located close by, the terraces are assumed to be associated with the Dry Prong site and of the same phase. See Woodbury (1961) for a full discussion of these rock lines and other land-use problems in the Point of Pines region.

The Great Kiva

The village had been built for some time prior to the construction of the kiva, as a trash mantle nearly 40 cm. thick had accumulated before the excavation for the structure (Fig. 3). The central section and the entrance were probably excavated in a single operation. The backdirt from this digging was spread in a low, wide mound around the periphery of the kiva, with the majority of the dirt dumped at the south and west sides, where the hill slope permitted easy disposal. The excavated native clay was either dumped carefully to grade or leveled to form a bench on all but the northern side. On this side of the kiva at least part of the bench consisted of a cut made into living stone where the bench face and top were made by excavating into a tuff deposit.

The center section of the kiva must have been a considerable undertaking for a people unequipped with metal tools. Across the western half of the kiva is an outcrop of the white tuff mentioned above, which though soft and chalky, is remarkably resistant to removal. Although it was not completely cleared, testing confirmed that the north bench was cut into this tuff, and nearly half of the floor surface was excavated into it, to depths of as much as half a meter. This stone sloped sharply toward the east and was replaced by a tough yellowish clay, shot through with small pebbles of tuff and hematite; this material is here called "native clay." This clay overlies the tuff in all undisturbed sections and forms the usual physical boundary for the original excavation.

The floor of the kiva was first the surface of the completed excavation. The heavily stained fill resisted separation both from the tuff and the native clay as a result of the "ponding" of water in the depression after abandonment. The necessity of picking this deposit loose removed any evidence of subsequent refloorings except in the southwestern corner of the kiva. Here a very dark section of thin floor plaster was recovered. Probably coatings of carefully sieved clay were applied when a need for smoothing or renovation was felt, however the main accretion of floor "plaster" would have been dust or tracked-in dirt.

The bench was nearly vertical, standing just less than a meter in completed height. Against the wall of native clay was laid a facing of unshaped basalt boulders set with a great deal of mortar and a few chinking stones. The wall was extremely difficult to define except on the western side of the kiva and was, in total effect, a singularly unimpressive architectural accomplishment. Slumping and erosion had further damaged the walls as had the probing roots of the large trees growing within the kiva depression. These roots followed the cleavage line between the native soil and the masonry and had succeeded in prying loose the wall stones in several sections. This difficulty of definition made clearing to the basic wall stone imperative, effectively removing any evidence of a mortar and spall veneer or a plaster. Neither of these wall finishing techniques were found in the kiva although patches of rubble veneer were present in Room 1 and Kiva Rooms 1 and 2. Plaster was not found on the walls of any room excavated. Bluhm (1957: 15) could not surely locate plaster on the walls of the Sawmill site kiva, but inferred from the presence of

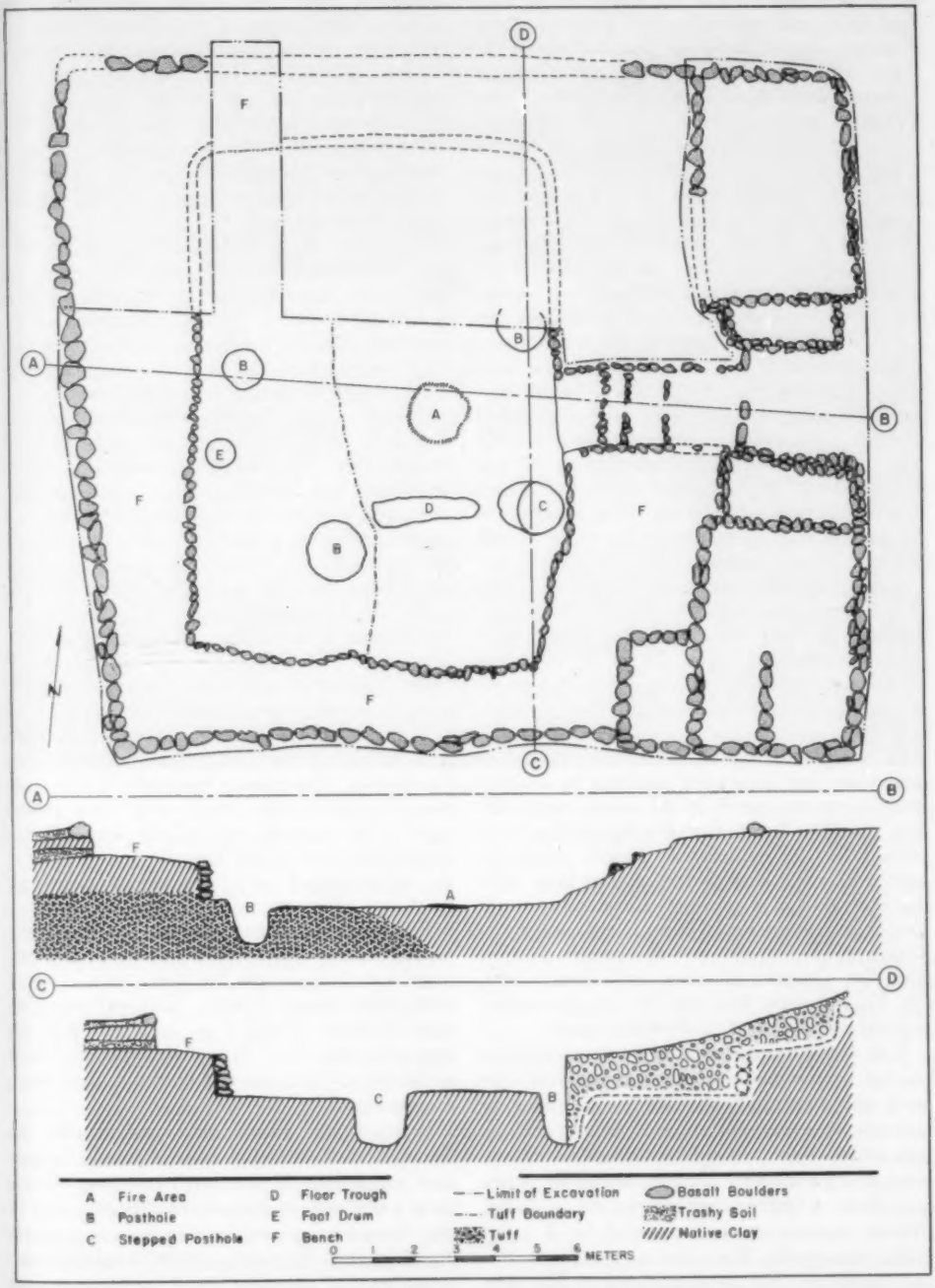

FIG. 3. Plan and sections of the Great Kiva at the Dry Prong site.

a lens of adobe clay at the bases of the walls that there had originally been a facing of this material. It could be suggested that at Dry Prong aesthetic considerations forced the application of some sort of wall coating to achieve a regular surface.

The original excavation of the entrance left a low step at the kiva floor and produced a steep ramp leading up to the old ground surface. This slope was improved by the construction of three rough steps, with the risers and steps made of irregularly spaced basalt boulders set in a dense and dark-colored mortar. The sides of the entrance were marked by masonry walls which competed in architectural competence with the bench facing. The steps went no farther than the outer wall of the kiva, at which point the entrance leveled and passed through a tier of rooms (Fig. 4). It is possible that originally the ramp expanded at the surface level and was bounded by the two largest rooms attached to the kiva. The addition of the smaller rooms constricting the entrance was probably a later feature.

Deep post holes had been dug for the studs of the central roof supports (Fig. 3). Two posts flanked the ramp on the eastern side; a post hole was centered about 1.5 m. in from the south wall, probably corresponding to one in the unexcavated portions of the kiva; a single post hole was found at the middle of the west wall in line with the entrance. This last mentioned pit may have been matched by another lying just to the north in the unexcavated section, but if so, it was not of sufficient size to be located by the exploratory trench along the west wall. The post pattern of this kiva, with the exception of a missing central post, corresponds with some faithfulness to that shown by Bluhm (1957, Fig. 5) and the pattern at Higgins Flat (Martin, Rinaldo, and Barter 1957, Fig. 4), two great kivas which may be considered representative of the Reserve region.

Both these Reserve area kivas were assumed to have been remodeled. The original roof supports were placed at the midline of the kiva, at right angles to the entrance. A later modification added posts around the periphery of the room and presumably changed the effect of the roof from a gabled appearance to a dome-shaped superstructure supported by a polygonal framework. The entrance presents a separate problem. The roofing of this considerable space has not been proved for any of the kivas excavated thus far. There were some post holes at the border of the Sawmill kiva entrance but hardly enough to support a covering framework. At the Dry Prong site it can be suggested that the room walls at either side of the entrance may have supported a roof over the entrance alley. At other kivas of this form the entrance facings may have been extended upward to a height to support a cover, but this has not been proved.

To return to the problem of roofing construction, the postulated alteration from a gabled roof to an essentially flat roof may be taken as a starting point. If the roof was entirely dismantled it would have been a major undertaking to remove the roofing elements, primarily earth, which would have tumbled into the kiva enclosure when the superstructure was dismantled. While certainly not impossible, it would seem more feasible, viewed by today's standards, to have constructed a flat roof support, and to have added more posts when roof sagging indicated a need for additional support. In any case, the original construction, postulated reconstruction, and total number of post holes left for contemporary interpretation permit a number of possible solutions to this problem. At the Dry Prong kiva there seem to be fewer choices of this nature, and a flat, polygonal beam structure is suggested.

The presence of Kiva Room 3 (Fig. 3) gives a vital clue to the roofing pattern of the Dry Prong kiva. The interior two walls of this room were footed on the bench and were butted against the exterior wall of the kiva. If this room was to serve any function except that of an eaves closet, it must have had sufficient wall height to allow access. Although nothing remains in place of the outer kiva wall but the footing course, the abundance of building material near it is ample for the construction of well over a meter of wall. This wall probably stood between 1 and 2 m. in height and the roof may well have been flat, supported both at the top of the wall and by the central beam framework.

Stringers would have been used to span this distance, these being of large diameter to support the weight of the earth covering. Other than a few split shake and reed impressions in clay there was no evidence for the various roofing elements. By analogy from dwelling units constructed during this phase, smaller wooden beams may have been placed across the string-

FIG. 4. The Great Kiva at the Dry Prong site, looking east. Meter scale.

ers with shakes and bunches of reeds or twigs used as the final organic cover. The heaping of earth over this framework would have provided a weatherproof seal.

The fire area was not restricted by construction and was recognizable only as a reddened patch of burned earth with a thin lens of overlying ash. This burned patch was directly in line with the entrance and was 2 m. in from the eastern edge of the floor. A shallow trough, which has often been described as a floor resonator or foot drum, was found directly west of one of the post holes flanking the entrance; a similar feature may be suspected to lie in the unexcavated section of the kiva. This feature, or an adaptation of it, is common in great kivas, and this particular type of trough was present both at Higgins Flat and at the Sawmill site; it has also been found in later kivas at Point of Pines. The possibility that these troughs once held loom anchors should be kept in mind.

A circular, straight-walled pit with a flat bottom had been dug just south of the post hole centered on the west wall. This was considered to be a foot drum and not a storage pit and may be compared with a similar pit found at the Higgins Flat site (Martin, Rinaldo, and Barter 1957: 18). A very comparable feature was found in a Tularosa phase small kiva at Arizona W:10:37 (Olson 1959); this pit had an offset for a plank or cover. No traces of organic substances which would suggest the material used as the resonator cover were found either in the troughs or the pit. Ethnographic evidence would suggest the use of a wooden plank to produce the necessary sound.

Lying immediately east of the outside wall of the kiva were four rooms which flanked the entrance in matched pairs. The room walls

butted against the kiva wall and the rooms were floored on the native clay back dirt from the original kiva excavation. The exterior masonry of these rooms continued the line of the northern and southern walls of the kiva. The larger rooms were comparable in size to the room excavated in the main room block. Between the two largest rooms and effectively constricting the entrance, were a pair of long, narrow rooms whose floor areas would have hardly been adequate for living purposes. The entrance alley led between these rooms and opened at the level of the plaza. Three stones had been placed across the entrance and may have been the footing course of a wall which further restricted entrance into the kiva.

Several interpretative possibilities are suggested by the arrangement of these four rooms. It would seem that the smaller rooms were entered at ground level; a useful hatch would have taken nearly all the roof area. It is tempting to postulate that these rooms, particularly those of ample size, were important in the preparations for various rituals or for the storage of ceremonial gear. Performers or celebrants at the various ceremonies may have lived in the rooms during the celebrations. The smaller rooms could either have been storage units or served as visual barriers between the entrance passage and the larger rooms. Another possibility for the use of the rooms is that they were living quarters for the persons responsible for the maintenance of the kiva. No traces of fires were found in any of these rooms and this scant evidence supports the inference that the rooms were not permanent dwelling units. This block of attached rooms is certainly one of the first examples of the eventual inclusion of a great kiva within the confines of a pueblo. It is indeed unfortunate that the contents of these rooms gave no more information pertaining to their use or function.

Domestic Structures

Two rooms exclusive of those attached to the kiva were excavated. The room examined in the room block measured 3 by 6 m. and the walls still stood from 70 cm. to 1 m. The workmanship on this particular unit was superior to that found in the kiva rooms or the kiva; care in the selection of stone and more uniform coursing gave a regular appearance to the masonry. While not finished to the extent often seen in Tularosa phase sites, this masonry was of much better quality than that found in many Reserve phase ruins. The quantity of stone in the fill left no doubt that there had been ample material for a single story. The wall was constructed of basalt boulders, unshaped but selected for regularity; in all walls but the north the masonry was coursed; mortar packed with spalls filled the larger spaces between stones. There were places where a veneer of smaller bits of rock in a thick mortar had been used as a wall facing, but this was removed during the excavation of the room. Along the base of the northern wall of the room, which was also the outside wall of the pueblo, the lower course of footing stones had been selected for a rather consistent length and regularity of face. The long dimension ran vertically, giving the wall the appearance of a course of slabs set around the edge of the floor. Examination proved that these stones were quite thick and had spanned the entire thickness of the wall. Above this footing the masonry was indistinguishable from that in the other walls. Though a single room is scanty evidence, it is possible that the exterior wall of the pueblo had been constructed in this manner, while the shared walls were of block footing construction. In later phases vertical slab footing is found frequently in kiva walls and occasionally in room construction, at least at Point of Pines.

The floor was plastered, or prepared by the importation of selected fill, as the surface stood nearly 10 cm. above the wall foot. The soft consistency of this material may indicate the accumulation of dirt which follows human occupancy. The fire area was a burned patch on the floor and was centered in the room. No evidence of the roof was found; at Point of Pines, rooms of the Reserve and Tularosa phases were roofed with beams, split shakes or reeds, and clay (Olson 1959). The pueblo, from the surface indications, appeared to have been built in several small units, but without complete excavation it was impossible to determine the construction sequence.

Scattered around the main room block were several small buildings, in no case more than two rooms to a unit. Half of one of the double rooms was excavated. Only a single course of stone remained; this may indicate that the superstructure was made of brush or that stone was removed from these units during the construction of the kiva or pueblo. There were no

features on the floor and this surface appeared to be only the cleared surface of the native clay with no further preparation. These small buildings may most easily be explained as storage units or fair-weather work areas. There was no evidence that the small rooms differed significantly in age from the remainder of the site.

Just west of the excavated unit structure was a slab-lined cist which was nearly a meter across the top and less than half a meter in diameter at the bottom. The slabs projected slightly above the surface of the ground and the top 20 cm. of fill was forest duff. Below this layer was 25 cm. of compact fill of a dark, brownish clay which was very similar to the native clay, except for the color. There was not enough charcoal in the fill to assume that this feature was a hearth and it should probably be considered as a storage bin.

RESERVOIR

Immediately west of the site there is an intermittent stream, from which a small channel leads off the main watercourse into a depressed area of circular outline (Fig. 2). The dark and silty surface of this small reservoir or tank is pocked with cattle tracks, indicating that some water is still trapped here. Summer rains may fill this pond to a foot or more, but these same rains make the road to the site impassable, so this hypothesis could not be tested.

A series of test trenches was dug across the maximum diameter of the pond to test the original view that this feature was a silt-filled walk-in well. The native clay was reached at just over a meter in all the tests and the contour of this material matched the surface of the fill; the bottom of the reservoir was gently concave and was not conical. There is no possibility that this aboriginal excavation tapped an aquifer as the native clay is highly impervious to water and was unbroken in all test sections.

The fill was a dark, compacted clay, admixed with silty bands and with a higher proportion of sand toward the bottom. There were indications of gravel which would indicate a rapid run-off, but the general composition of the fill showed a gradual accumulation from the settling out of soil particles, organic decomposition, and the trapping of windborne elements.

While not plentiful, sherds were present throughout the fill below the top few centimeters of silty fill. Leaching by soil acids had altered the surfaces of the fragments and indicated a much wetter environment than could be duplicated elsewhere on the site. No stratigraphic ceramic differences were noted. The sample matched that found in the remainder of the ruin except for a higher incidence of plain and textured types. This could most easily be explained by the use of these utility vessels as water containers. Wheat (1952: 194–5) did not note this ceramic emphasis in the water sources that he investigated.

POTTERY

A total of 4067 sherds was recovered from the excavations: 599 sherds were obtained from the kiva fill, 1103 from room testing, 89 from the reservoir fill, and 2276 sherds were found in the main trash deposit. These samples have been combined as analysis showed no significant horizontal or vertical stratigraphic difference; the entire sample is used as the criterion for the phase designation of the site and all its features.

The type analysis is as follows:

Alma Plain (Haury 1936a: 32): 2397 sherds.

Alma Scored (Haury 1936a: 38): 4 sherds.

Encinas Red-on-brown (Sayles 1945: 43): 10 sherds.

Mangas Black-on-white (Cosgrove and Cosgrove 1932: 76–9): 1 sherd.

Mimbres Black-on-white (Cosgrove and Cosgrove 1932: 72–6): 44 sherds.

Nantack Red-on-brown (Breternitz 1959: 29–30): 7 sherds.

Pine Flat Neck Corrugated (Breternitz 1959: 25–7; Gifford 1957): 125 sherds.

Reserve Black-on-white (Martin and Rinaldo 1950: 502–3): 96 sherds.

Reserve Incised Corrugated (Rinaldo and Bluhm 1956: 164–7): 227 sherds.

Reserve Indented Corrugated (Rinaldo and Bluhm 1956: 159): 7 sherds.

Reserve Plain Corrugated (Rinaldo and Bluhm 1956: 155–7): 322 sherds.

Reserve Punched Corrugated (Rinaldo and Bluhm 1956: 162–4): 32 sherds.

Reserve Red (Nesbitt 1938: 98–9; Gifford 1957; Olson 1959): 403 sherds.

Reserve Smudged (Nesbitt 1938: 97–9; Martin, Rinaldo, and Antevs 1949: 187): 326 sherds.

Sacaton Red-on-buff: Safford Variety (Breternitz 1959: 30; Gifford 1957; Olson 1959): 8 sherds.

Tularosa Patterned Corrugated (Rinaldo and Bluhm 1956: 169): 4 sherds.

Unidentifiable Black-on-white: 54 sherds.

I have resisted creating varieties of the several types of utility ceramics that can be assumed to have been made locally at the Dry

Prong site. The distinctiveness of a paste deriving from a particular geographical clay source may justify varietal status in many cases, especially if the distinction supports a temporal or spatial inference. But if the new-found taxonomic panacea of "variety" is proliferated in the same manner as were types, we have gained little in taxonomic clarity.

There are some minor differences in the Dry Prong utility types which set them apart from the published descriptions. Tempering elements differ megascopically from the tuff temper with its included gold mica which is dominant at Point of Pines. The white to pinkish, non-micaceous tuff temper of the Dry Prong material is also in contrast with the sand temper described for the Reserve, New Mexico, region. This may be most simply explained by assuming that a local source served for pottery clay and that no important cultural distinction is present. Therefore, no temporal or spatial differences can safely be implied. Whether the ceramic varieties based on tempering elements, as at Point of Pines (Wheat 1954; Breternitz 1959; Olson 1959), will be useful remains to be demonstrated more conclusively. Without sharp stylistic differences and lacking non-cultural dating controls, there is precious little left to set these pottery fragments apart from the original descriptions. As this site demonstrates a short temporal span, it would seem most advisable to operate, at present, within the published types.

Decorated types which are sensitive dating indicators are not present in the sample; in fact, the majority of types present here have been dated themselves by ceramic associations. The total time span of the dominant decorated type, Reserve Black-on-white, has been dated with something less than precision to the period from A.D. 1000 to 1150. There are varieties of this type which show stylistic elements considered to appear early in its development. During the terminal portion of the taxonomic distinction of Reserve Black-on-white, the gradual replacement by Tularosa Black-on-white complicates sorting. These features, and intrusive types when available, are the usual justifications for the assignment of a particular sample of sherds early or late within the span of the type.

In the sherds of Reserve Black-on-white from this site, early stylistic elements were lacking as were any sherds which were assignable to the Tularosa decorative style. The sample was rather clear-cut and fitted the published description well. The complications or assistance of intrusive types were minimal. But before delving into the relationships of the several types in the sample, it would be best to consider the dominant type.

Reserve Black-on-white was the most common decorated type found at the site. The general practice of phasal classification in the Southwest would automatically place the ruin in Reserve phase. The dominant decorated type is the basis for this classification and it should be pointed out that the other elements of cultural content found at the site are not important in this regard. For example, given the complex present at the site, if the dominant type had been Four Mile Polychrome with its date in the late 14th century, an entirely different explanation would have to be made for the phase assignment of the site. While this may appear a restatement of the obvious, it is interesting to note how much lip service is paid to the use of non-ceramic elements as phase determinants, while the actual classification is made on the basis of a minimal number of dominant types present in any given context. It follows that the geographical extension of the type is also calculated on dominance and by this means are the boundaries of a given phase set.

This should not raise the specter of the importance of ceramics to the Southwesternist to the exclusion of any cultural interpretation. Ceramic elements, as well as the remainder of archaeological culture items, cannot be understood or synthesized through the compartmentalization of taxonomic practice. Synthesis operating within the framework of the functional relationship of all these elements holds the most contemporary promise. This, however, is a separate responsibility which obtains after the formation of valid and easily recognizable phases. These conceptual entities, with their fluid and varying relationships of cultural content, space, and time, provide one of the easiest means for the segmentation of archaeological culture into manageable units, units which are relatively free of historical or evolutionary bias. This is not to say that these units cannot be arranged in structures which exploit these or other approaches, but the phases themselves are hopefully assumed to be discrete, bias-free units.

To return to the phase classification of Dry Prong, the dominance of Reserve Black-on-white would place the site in the Reserve phase, and the occupation of the site could be dated within the last part of the 11th century or early in the 12th. The geographical location of the site is inside the boundaries of Reserve phase (Olson 1959), an area which can be roughly bounded by Point of Pines, the White Mountains, Reserve, New Mexico, and Morenci, Arizona.

The intrusive sherds do not shed much light on the dating of the site. Mangas Black-on-white can be eliminated from consideration as the single sherd found was modified into an artifact. The virtual absence of this type is interesting as it may indicate that this type was no longer popular enough to be imported. The emphasis upon Mimbres Black-on-white would place the site in time after the span of Mangas, probably some time after A.D. 1100. Mimbres Black-on-white is usually considered to fall in time between 1100 and 1200, possibly disappearing as a type before A.D. 1200. Northern black-on-whites with precisely dated spans are lacking from this sample and their place is taken by a number of intrusives of a southern origin. The Safford Variety of Sacaton Red-on-buff has been assumed to occur late in the Sacaton phase, on the basis of a reverse dating provided by the presence of the type in Reserve and Tularosa phase contexts. The type has not been described from any excavations in its home area and can only tentatively be dated or described. Encinas Red-on-brown was not securely dated in the original description of the type and there has been no recent amplification of the status of this form. At Point of Pines, however, the type is consistently associated with Reserve Black-on-white and lasts well into the Tularosa phase, although in decreasing numbers. These two southern types can be considered evidence of more than a casual contact with the Middle Gila River area and with peoples of the Hohokam and Mogollon traditions. Nantack Red-on-brown is a very imperfectly known type and appears to be a late Point of Pines expression of the early Mogollon red-on-brown tradition, perhaps influenced as well by Encinas Red-on-brown.

The unpainted types are those usually found with Reserve Black-on-white. Alma Plain and its variants have a tremendous time span and show little typological change, but are a valid indicator of the general Mogollon tradition of brown-paste utility ceramics. Reserve Red is a derivative of San Francisco Red and can be differentiated from it by vessel shape and the lack of careful surface finish; this type and Alma Plain can seldom be separated, on the basis of single sherds, from earlier and later forms of the types. Reserve Smudged is the companion to Alma Plain and probably represents those Alma Plain bowls that were smudged. It also suffers from an excessive temporal span.

Pine Flat Neck Corrugated is an early indented neck corrugated form which is found, at present, only within the Point of Pines region. It appears in the Nantack phase after A.D. 900 and lasts through Reserve phase. Reserve Plain Corrugated, Reserve Incised Corrugated, and Reserve Punched Corrugated should be considered stylistic variants of a single type, Reserve Plain Corrugated. This technique, an outgrowth of Three Circle Neck Corrugated, first appears as a neck decoration of vessels and soon was used to cover the entire surface of the vessel. Upon this corrugated base were applied various secondary decorations such as incising and punching. Indented corrugation was originally confined to the necks of vessels but was quickly applied to all-over corrugation. It appears early in Reserve phase and finds its highest expression in Tularosa phase, but lasted several centuries later at Point of Pines. Tularosa Patterned Corrugated in its several varieties may be most simply described as the combination of plain and indented corrugation styles. This type was begun in Reserve phase, lasted through Tularosa phase, and was continued much later at Point of Pines, lasting nearly to A.D. 1400.

Several features of this ceramic sample are at variance with previously reported sites. There was a definite lack of the interior smudging which is described as a varietal expression of several of the corrugated types. Reserve or Tularosa Fillet Rim, types which are usually common in this phase, are lacking. No explanation can be offered for these problems. If a value judgment may be intruded, the entire sample seems to lack the sophistication found in Reserve phase sites at either Reserve, New Mexico, or Point of Pines, Arizona. This may just be a feature of geographical isolation or

cultural preference. Unfortunately, neither of these postulates can be supported completely by the material recovered from Dry Prong site.

Artifacts

The materials used for chipped tools were andesite and obsidian. Volcanic material is available in a number of localities near the site, occurring either in outcrops or boulders derived from these deposits. In its unmodified state obsidian occurs in small nodules with a vitreous crust; this tool stone is not found locally. Numerous flakes of andesitic tool material were found on the surface of the site, but the number of tools found of this stone were few. These artifacts reflected the durable and rather intractable nature of the stone in their larger outlines and bulkier cross sections. Obsidian was obviously preferred for small tools because of the greater control it gave the artisan for precision retouching; projectile points particularly reflect this choice.

One blade and two large and rather crude projectile points (Fig. 5 *g, h*) were made of fine-grained andesite. The final chipping on these points was coarse and the tools were thick in cross section. These three artifacts and a large chip point of obsidian came from the surface of the ruin. The predominant outline of projectile points was triangular with paired side notches placed close to the base with one or more additional notches on one side (Fig. 5 *a–f, i*). These multiple notched forms were always made of obsidian and were finely retouched. Two came from the surface and the remainder from the excavated sections of the ruin.

Fig. 5. Projectile points from the Dry Prong site. Height of *a* 2.6 cm.

These eccentric forms compare with the points found by Bluhm (1957: 46) to be common at the Sawmill site and the type was listed as typical among the later points at the Swarts ruin (Cosgrove and Cosgrove 1932: 47). This point style is common in the Museum of Northern Arizona collections from the Mimbres region and is infrequently found at Point of Pines. It may represent an intrusion from the Mimbres area.

Dense and vesicular basalts were to be found within a short distance of the pueblo and were used for all milling tools. Tuff was used for grinding and abrading stones when durability was not as important. The only evidence for metates, other than the wear pattern on manos, was a single fragment of a troughed type. Manos ranged in width from 7.5 to 14.5 cm., and in thickness from well worn tools at 2.3 cm. to presumably freshly finished specimens as thick as 5.5 cm. Lengths cannot be given as no whole specimens were found. All the manos showed the sharply upcurving ends associated with use in a trough metate. One was finished with finger grooves on the edges; all specimens were unifacial with slight smoothing on the reverse side.

Two rubbing stones, one of vesicular basalt and the other of dense basalt, were of hand-size and were respectively bifacial and unifacial, with little wear shown on the used face. A small tabular piece of basalt had been chipped to a trapezoidal outline and smoothed on both faces to a very even surface; this may have been a palette of some sort. Another small rubbing stone was nearly square in outline; the grinding of a regular, flat face had produced a thin cross section. These tools were random in their distribution and no concentrations were noted. A fragment of a three-quarter grooved ax appeared to have served out its usefulness as a maul. From the fill of Room 1 came half of a well finished scoria bowl which had a diameter of 13 cm. and a depth of 3.2 cm.

Two fragments of *Glycymerus* bracelets came from the broadside trenching. One had been additionally modified by a biconical perforation near one end, probably to allow suspension. One nearly complete zoomorphic effigy and the posterior section of another came from the same testing. These were crudely modeled and left considerable leeway in the assumption of the species represented. A rod-like section of fired clay may have been a portion of a different type of effigy.

Modified potsherds were the most frequently encountered artifact, with the majority (16 specimens) coming from Broadside 1; of the remaining five, three came from the kiva fill and the others from Room 1 fill. Eleven were perforated discs ranging in diameter from 2.6 to 7.1 cm. Two were made from Reserve Black-on-white sherds, one from a sherd of Reserve Red, and the remainder from Alma Plain. Seven sherd discs and three oval worked sherds complete the sample. For these shapes Alma Plain was the dominant material with the exception of the disc made from a Mangas Black-on-white sherd.

Non-artifactual Material

Malachite and hematite were found in several excavations and may be considered paint sources in the raw, powdered form; the hematite may have been used for ceramic decoration as well. The malachite was probably derived from surface sources to the south along Eagle Creek, possibly in the vicinity of the modern copper mining towns of Morenci and Clifton. The hematite occurs in a low-grade, crumbly form as nodules in the

native clay; a few pieces of a much denser hematite must have come from another source. Two pieces of impure calcite came from the kiva fill and may have been used as white pigment or merely to satisfy an ancient curiosity.

CONCLUSIONS

There is no need to review the entire development of early Mogollon ceremonial architecture, to borrow a term from Wheat (1955), as these structures are adequately synthesized in the source quoted and by Martin (Martin, Rinaldo, and Barter 1957). But it would be germane to examine the various phases immediately preceding the Reserve phase.

At Point of Pines the Three Circle phase does not appear in a taxonomically recognizable position before Reserve phase; the Nantack phase occupies the same relative position in the regional sequence. At the Nantack Village, Breternitz (1959) excavated a great kiva (Fig. 6) which was roughly rectangular and semi-subterranean with dirt walls. The entrance was broad and also had no masonry in its construction. The roof was built on a central framework supported by rather irregularly placed posts. The village pattern consisted of pit houses loosely grouped around the kiva.

In the Reserve, New Mexico, region there do not appear to be any definite antecedents, in the formal sense, for the rectangular, ramped kivas found there. According to Bluhm (1957) and Martin (Martin, Rinaldo, and Barter 1957), this type of structure is not found before very late Three Circle phase or early Reserve phase. More excavation in late Three Circle sites, with their rectangular pit houses and sporadic use of masonry, might clarify this problem.

The distribution of the ramped, rectangular great kiva is rather scattered (Fig. 1) because each kiva served a number of communities. The main concentration of these buildings is in the eastern portion of the Reserve phase region. The sudden appearance of the form suggests an architectural innovation of greater intensity than can usually be demonstrated on the archaeological level. It would seem that a formal change was added to the general concept of great kivas during the terminal portion of the Three Circle phase and that these kivas were the dominant form during Reserve and Tularosa phases.

In a search for origins the first area to consider would be that lying to the south and east, described by Lehmer (1948) as the Jornada branch of the Mogollon. Lehmer described two complementary sets of three phases, divided on a north-south basis. Beginning in the Mesilla and Capitan phases, respectively southern and northern, there was contact with the Mimbres area, expressed in traded pottery. El Paso Polychrome, a dominant late type in the Jornada branch, was traded back into the Mimbres in return (Cosgrove and Cosgrove 1932: 93). Trade was maintained during the Three Rivers and Dona Ana phases but slacked during the final Jornada phases. There are secular architectural similarities between the Jornada and Mimbres areas, expressed first in the shapes of pit houses and later in irregular pueblos, but great kivas of a rectangular outline were lacking. The only structure of this nature was circular with a complete bench. It is interesting to note that there was little ceramic evidence of contact between the Reserve phase region and the Jornada branch; El Paso Polychrome is intrusive at Point of Pines, but in a much later context and indicates contact during the maximum development and extent of El Paso phase, the culmination of the Jornada branch.

The Reserve and Mimbres phase regions developed from a base that was essentially similar. If one is not overawed by the superb Mimbres ceramic tradition, the levels of cultural attainment in both regions can be equated almost directly. During Three Circle phase the main difference between the various regions was in the types and percentages of intrusive and local potteries; architecture was very similar throughout all these regions. By Mimbres phase, or possibly late Mangas phase (Danson 1957: 17–18), separate ceramic traditions had developed at Point of Pines and in the Reserve, New Mexico, regions. There was still much contact; witness the more than three-to-one dominance of Mimbres types over Reserve Black-on-white at the Sawmill site (Bluhm 1957: 30). Other sites in the same area do not show this percentage and it may be suspected that the Sawmill site represents a frontier situation (Danson 1957). Mimbres intrusives are common at Point of Pines in Reserve and Tularosa sites (Olson 1959), but occur less frequently than at the Sawmill site.

A survey of the major excavations in the Mimbres region offers some suggestions on the development of these great kivas. At the Harris Village (Haury 1936b, Pl. 26 *a*, *b*) House 10 (Fig. 6) was large and rectangular, and had a narrow, ramped eastern entrance. The main

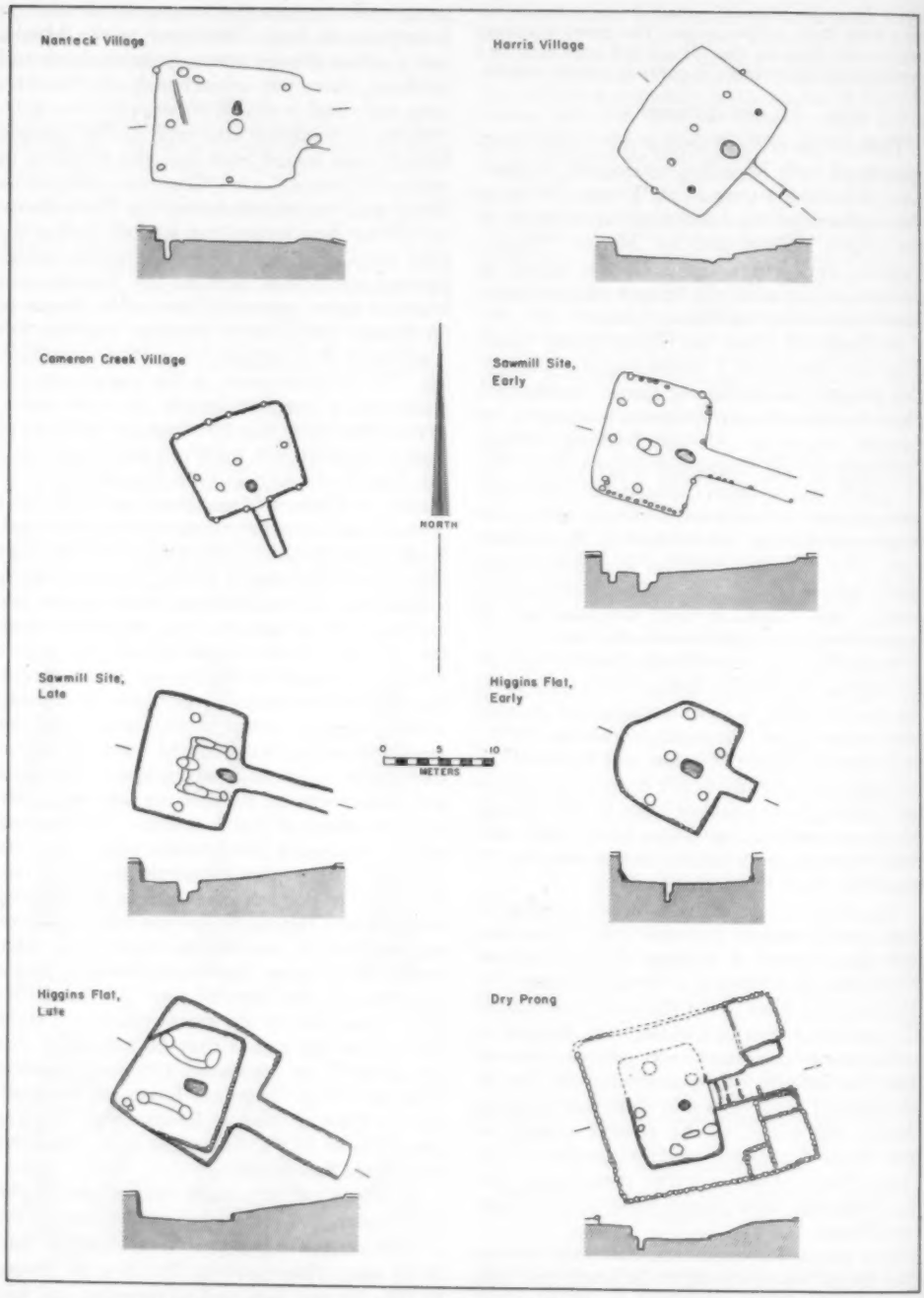

Fig. 6. A comparison of ramped, rectangular great kivas from the Reserve-Tularosa and Mimbres regions.

post holes were on the central north-south axis, and supplementary posts were partially enclosed by the walls. This structure was nearly 12 m. in greatest width and fits the definition of a great kiva given above. There was a large central hearth in line with the entrance and two supplementary hearths in the northeast and southeast corners. The entrance had a step at the room edge and had a transverse gutter near the upper end. The room was listed as ceremonial and dated in Three Circle phase.

At the Cameron Creek Village (Bradfield 1931) there was a rectangular, ramped great kiva. This site, an extremely complex one, spanned Three Circle through Mimbres phases. A variety of architectural forms was present, from deep round and rectangular pit houses to rather amorphous pueblo blocks.

The kiva was placed on a "waist" in the mesa top between two pit house clusters. A total of four pueblos, two at each side of the kiva, overlay the earlier villages. The kiva (Fig. 6) was rectangular and subterranean, masonry lined, and had a broad, stepped entrance leading out to the southwest. The main post supports were centered at a right angle to the entrance; supplementary posts were located along the walls. The structure was over 8 m. on both long dimensions, but the paired walls were not equal in length. The peripheral posts were partially included within the walls as at the Harris, Sawmill, and Higgins Flat sites.

Bradfield (1931: 23) states that, from subfloor evidence, the kiva was built during the latest occupation of the deep pit houses; presumably this would be during the terminal portion of Three Circle phase. The structure was probably in use through the Mimbres phase, that of the four pueblos, and would overlap the final portion of Reserve phase. Unfortunately, the absence of sherd counts for the various structures and the minimizing of intrusives does not permit checking the supposition given above for the span of use of the kiva.

At the Swarts ruin (Cosgrove and Cosgrove 1932) there were several large rectangular structures which, in formal attributes, suggest great kivas. The earliest structures were subterranean and rectangular, a pattern which persisted until the third or "Middle Period." In the second or "Transitional" period, Room AE was 9.4 m. in the short dimension by 11.2–11.9 m. in the long dimension and had an irregular post pattern including wall-surrounded posts. The fire pit was over a meter in diameter and was centered near the east wall. The rectangular outline continued in use through the Middle period, but the structures were no longer built below ground and more masonry was used. There was a pit which suggested a foot drum in a large room in use during this period. Also in use was a large enclosure, 6.8 by 11.5 m. in length, which was described as a roofed plaza. It had a central fire area and there were three posts located on the long axis of the room. The entrance patterns, other than a door in Room Y, were not clear, but the ramped entrance was not found in these large rooms. The Cosgroves separated these structures from the ordinary dwelling units and they should be considered as part of the problem of rectangular great kivas. The roofed plaza is interesting when it is compared with the Foote Canyon site (Rinaldo 1959) where there was both a roofed plaza and a rectangular, ramped great kiva.

At the Pendleton Ruin (Kidder, Cosgrove, and Cosgrove 1949), admittedly a much later site, there was no evidence for the type of kiva considered here. Contact with the Mimbres area was noted, but only in ceramics and possibly in the pueblo style of construction.

Farther to the west, in the area described as the San Simon branch (Sayles 1945), no great kivas of this sort have been reported. Sayles presented the development of a Mogollon cultural variant, the later phases of which were considerably influenced by Mimbres and Hohokam stimulus. Intrusives from the Encinas phase are not common in the eastern portion of the Reserve phase region, but they are often found in ruins at Point of Pines. Trade back to the south was much less marked. Pit houses persisted throughout the entire San Simon sequence and the only evidence of group effort was a ball court which was attributed to the early Encinas phase. No evidence of, or the stimulus for, the rectangular, ramped great kiva was found.

West and north of the San Simon region, along the "Middle Gila," there are a number of sites which may be considered an eastern extension of the Hohokam. The area probably reached its maximum cultural height during the unfortunately long Sacaton phase. Archaeological work, after the early surveys in the first decades of the century, has been minimal. Sacaton Red-on-buff: Safford Variant is a common

intrusive into the Point of Pines region during Reserve and Tularosa phases. Other objects such as shell, carved stone, certain ax and projectile types, undoubtedly came through the Safford region if they were not made there. It would seem unlikely that the rectangular great kiva would stem from this region, but until more is known of late Hohokam ceremonial architecture it would be well not to discount the possibility of stimulus from this source.

The Globe region may be described in similar terms, but here the excavation has been almost entirely restricted to the late ruins. San Carlos Red-on-brown appears at Point of Pines during Reserve phase and Pinto Polychrome can be found in some late Tularosa phase ruins. Early architectural forms are so poorly known that no conclusions can be drawn, except that no rectangular, ramped great kivas have been found in the Globe region.

Northwest of the Reserve phase region Haury (1950) has described a series of great kivas for the Forestdale branch. Unfortunately, during the comparable period of time considered, no kiva was excavated and reported. The circular, benched, and masonry lined kiva at Arizona P:16:2 was subterranean and probably had a four post studding. A stepped entrance led up to the surface and several rooms were attached to the exterior of the kiva, although the structure was separated from the main room block. The circular outline would fit the pattern shown by most Anasazi great kivas. The ruin would compare most directly with the Tularosa phase, but there were definite points of similarity with the Dry Prong kiva.

The border of the Reserve phase lies somewhere between Point of Pines and Forestdale but has never been placed definitely. Ceramic contact is found at Point of Pines which points to the north during Reserve phase (Olson 1959), but cultural transfers of other sorts are harder to isolate. The Dry Prong sample did not contain any sherds which could be assigned to the Forestdale region. The Dry Prong site lies approximately three-fourths of the way from Reserve to Point of Pines and may represent an extension from the eastern portion of the phase area.

Directly north of the Reserve phase region the White Mountains effectively blocked any contact except around the flanks. There is a discernable difference in the evidence for northern contact which derives from the east or west of this mountain group. At the present, with the exception of a definite suspicion that this northern area was the basic contributor to Reserve phase, no comparisons can be drawn due to the lack of published reports. The present research programs operating in the region should provide some of the information needed. So, having completed the circle around the Reserve phase region, there is still no definite group or groups from which the rectangular, ramped great kiva can be drawn. But when viewed as a complex, derivation from the north seems to offer the most promise.

Structures which are easily differentiated in size from the dwelling units are found in the earliest Mogollon phases and the use of these structures continues during the time that the Mogollon had the greatest cultural individuality of their own. While these early kiva structures were patterned on the dwelling units, they gradually added more and more features which set them apart.

By Three Circle phase time, or roughly the 10th century, there was a definite incursion of Anasazi traits into the northern Mogollon, expressed mainly in black-on-white pottery, the beginnings of masonry, and some tool and ornament types. This stimulus later resulted in the submergence of the Mogollon as a group easily differentiated from the remainder of the central Southwest.

In Reserve phase a new village plan and above-ground masonry had been adopted, a northern-derived style of decorated pottery had supplanted most Mogollon types, and a new variation of the great kiva had been introduced and accepted. Conceptual and material contact with the north continued. Ceramic intrusives from southern areas were common, but the direction of cultural change was toward a northern norm. The retention of the pit house in combination with the masonry pueblo and the continuing utility ceramics were expressions of portions of the Mogollon tradition. The Reserve phase marks the definite acculturation of the Mogollon which led to the development of the cultural centers which Reed (1948) has termed Western Pueblo.

The great kiva now seems to be a native Southwestern development, stemming from a need for a building to accommodate village or intervillage groups for mass ceremonies, a structure which expanded in size with the increase of village size. But at the same time there are

elements stemming from a southern influence which should not be disregarded. Recent studies have posed the possibility of far greater influence from Mesoamerican sources than had previously been recognized. With the study of what now appears to be the "northern periphery," many of the developments and refinements in sacred architecture in the Southwest may eventually be traced to this source, diluted as they may be by distance and varied interpretation, but Mesoamerican nonetheless. It will be most interesting to see what future research will provide to illuminate this problem.

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Flagstaff, Ariz.
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ARCHAEOLOGICAL IMPLICATIONS OF THE MODERN POTTERY OF ACATLÁN, PUEBLA, MEXICO

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ABSTRACT

The foot-turned *parador* or mobile pottery support used at Acatlán is very similar to the *kabal* used at the Maya village of Mama, Yucatán. It is viewed as an extension of the Maya *kabal* technique into the mold-technique area of central Mexico. It is suggested that the principle of the Maya *kabal* and its Acatlán counterpart may have been known and used by the Olmec of La Venta. Several vessels from La Venta which resemble the Mama type of *kabal* offer evidence for the possible antiquity of the *kabal-parador* technique of pottery making.

BOTH the archaeological and modern pottery of Mexico are well known, and representative specimens from most parts of the country are found in museums in Mexico and the United States. But, whereas contemporary pottery-making techniques have been rather thoroughly described (Foster 1955, Thompson 1958), little attention has been paid to the mode of manufacture of archaeological wares. This state of affairs is due to the fact that archaeologists, with several exceptions, know little about contemporary techniques and, conversely, most ethnologists have not examined the archaeological record with the problem of manufacture in mind. Although much contemporary work has been influenced by postconquest Spanish influence — especially the use of glazes, the wheel, the simple Mediterranean kiln, and some kinds of molds — it is apparent that indigenous techniques persist, sometimes even in areas where the native language has disappeared. Thompson assumes that the Yucatecan *kabal* is preconquest, even though the word does not appear in the literature until the mid-17th century, and even though no archaeological examples have been found. I have concluded, largely but not entirely on the basis of comparative evidence, that the vertical halves molds of modern Michoacán are postconquest, but that the "mushroom" molds, at least in a handle-less form, are preconquest. Generally, however, little systematic attention has been given to the problem of identifying the modes of manufacture of archaeological ceramics, and in relating them to modern survivals.

In this paper an attempt is made to link modern Yucatecan and Acatlán techniques with those of the Olmec of La Venta. Specifically, it is suggested that the principle of the Mayan *kabal* and its Puebla counterpart may have been known and used by the Olmec. This hypothesis is plausible for several reasons: some La Venta vessels are very similar in form to the modern pottery-saucer type of *kabal*; La Venta lies approximately midway between the two contemporary *kabal* occurrences; semi-*kabal* techniques are used in a number of southern Mexican villages of Indian speech, where Spanish pottery techniques are minimal. To develop the argument it is necessary to summarize Thompson's description of the *kabal*, and to describe in some detail the Acatlán techniques.

Today the *kabal* is used in about a dozen centers in the states of Yucatán and Campeche. The most common form is a wooden cylinder 10 to 16 cm. in diameter and 6 to 10 cm. high. The bottom, which rests on a board placed on the ground, is rubbed with wax, tallow, or soap to reduce friction. The potter sits on a low stool and turns this mobile base with toes or soles of the feet, forming the vessel either by modeling from a single lump of paste or by segmental building with thick coils. Both male and female potters work in this fashion (Thompson 1958, Fig. 18 *a–e*).

For comparative and historical purposes, however, the unique Mama variant is most significant. Here the *kabal* is a flat-bottomed pottery saucer with flaring sides, averaging 10 cm. in diameter at the base, 22 cm. at the rim, and 5 cm. in height. A *petecché*, a wooden disc about 1 cm. thick and 20 cm. in diameter, rests on top and just inside the lip of the *kabal*, providing the surface on which vessels are built (Thompson 1958: 76, Fig. 18 *h–i*). Only women make pots in Mama.

The principle of a mobile base on which to build pots is fairly widespread in Oaxaca and Chiapas; usually it is called *molde* in Spanish, and is variously made of wood or pottery (Foster 1955: 31–2, map). In two recorded places in southern Veracruz and one in Tabasco pots are modeled from a single lump of paste in such fashion that a part of the paste temporarily serves as a cylindrical support and mobile base which is slowly turned during the work. When the vessel nears completion this base is de-

tached. Functionally it may be considered as the equivalent of the common form of *kabal*, except that it is not turned with the feet (Foster 1955: 21–2, 32, map). In comparative perspective, then, the Mayan *kabal* is seen to be a specialized variant of a more general principle. Foot-turning is what sets it off from all other mobile base techniques, with the exception of the recently-discovered Acatlán homologue. Even foot-turning, however, is not a completely distinctive criterion. In the famous Zapotec-speaking Oaxacan town of San Bartolo Coyotepec at least one skilled potter, Maximino Mateo, uses his bare feet in balancing and stabilizing large vessels built on pottery saucer *moldes* in a fashion that is very suggestive of *kabal* motor patterns, even though he does not actually rotate the *moldes* with his feet (Foster 1959, Pls. 1, 2).

In 1958 I learned from Antonin Brejnik, pottery specialist with the UNESCO Fundamental Education Center (CREFAL) at Pátzcuaro, that foot-turning was used in Acatlán. He kindly supplied me with a photograph clearly showing a *kabal* technique of the Mama type (Foster 1959, Pl. 1, No. 1). This obviously was a critical discovery, since it placed foot-turning on opposite edges of the mobile base distribution area, thereby raising the distinct possibility of contemporary and prehistoric use of the technique in intervening areas. In the spring of 1959 I took advantage of a brief trip to Mexico to visit Acatlán, where the notes in this paper were recorded April 5–6. Since this is one of the most important pottery-making towns in Mexico, and since the work is previously undescribed, most of the data gathered are reproduced, even though some are not immediately pertinent to the theoretical problem at hand.

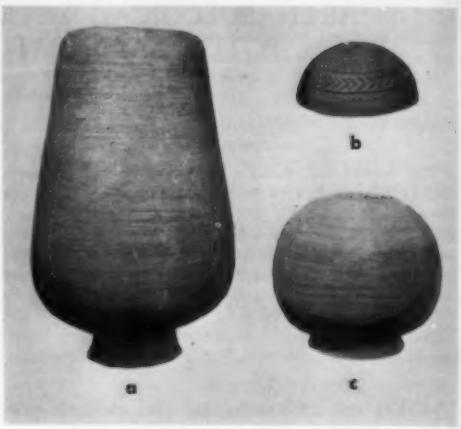

Fig. 2. Pottery molds from Acatlán. *a*, mold for water jar (*cantimplora*); *b*, mold for grinding bowl (*molcajete*); *c*, mold for cooking pot (*olla*).

The two potters who have most contact with tourists and commercial buyers are Herón Martínez Mendoza (Avenida Ricardo R. Márquez Núm. 27, according to his business card), a short distance up the hill on the left side of the road as one enters town southbound, and Cirilo Juárez, who has a big shop on the main highway a short distance from Herón. Most of my data are from watching Herón and three relatives work, and from their verbal amplifications, but I also visited briefly two other potters for supplementary and corroborative data.

Acatlán, which according to Herón has a population of about 14,000, is on the Mexico City–Oaxaca highway about 100 miles south of Puebla, a short distance before reaching the

Fig. 1. Mobile pottery support used at Acatlán, Puebla. An unglazed floor tile (*ladrillo*) rests on the pottery base (*parador*).

Fig. 3. Pottery-making tools used at Acatlán. *a*, smooth corncob; *b*, *c*, rough corncobs; *d*, reed knife; *e*, gourd scraper.

FIG. 4. Water jars from Acatlán. *a, cantimplora; b, tinaja.*

Oaxaca border. It is in what he calls the *Mixteca chica*. Mixtec is spoken in surrounding villages, and by a few people in Acatlán which has, however, become essentially a mestizo Spanish-speaking community. Pottery is made by appproximately 200 individuals, members of about 80 families concentrated in three of the town's 13 barrios: San Rafael, San Gabriel, and La Palma, all on the east side of the highway in the northern part of town.

FIG. 5. Effigy and special vessel forms from Acatlán. *a, toro; b, pato; c, chimbul.*

Tools used in making pottery at Acatlán are:

Parador. A flat-bottomed pottery saucer or casserole with flaring sides, averaging 17 cm. in diameter at the base, 42 cm. at the rim, and 10 cm. in height (Fig. 1, bottom). The flat bottom of a used *parador* is much abraded from being rotated on the ground or on a reed mat. The *parador* is homologous to the Mama *kabal*.

Ladrillo. A common, square, unglazed floor tile averaging 27 cm. in diameter (Fig. 1, top).

Moldes. Pottery molds over which a variety of forms are shaped. These are of the size and shape of the interior of the vessels made on them, a bit thicker and heavier than the pots themselves so as to withstand the strain and rough treatment of work. Exteriors are striated to give a rough surface, and shoulders, necks and rims are carefully finished and sometimes decorated with simple incisions, even though these artistic touches have no functional significance. These decorations, however, if found on sherds probably would mislead an archaeologist into believing that he had a bit of a pot rather than a mold (Fig 2).

Elote liso. A smooth corncob (Fig. 3 *a*).

Elote shañudo. A rough corncob (Fig. 3 *b, c*).

Carrizo. A reed knife (Fig. 3 *d*).

Cuchara. A small bit of *jícara*, the shell of the Middle American tree gourd, *Crescentia cujete* (Fig. 3 *e*).

Trapo. A rag.

A pottery disc about 45 cm. in diameter. This serves for rolling long, smooth coils used as swan's necks and for other special purposes.

The traditional forms of Acatlán pottery are easily recognized, and are not duplicated elsewhere in Mexico. More common vessels are:

Cantimplora. A water jar, resembling a Greek vase with three handles, averaging 40 cm. in height (Fig. 4 *a*).

Tinaja. A two-handled water jar averaging 33 cm. in height (Fig. 4 *b*).

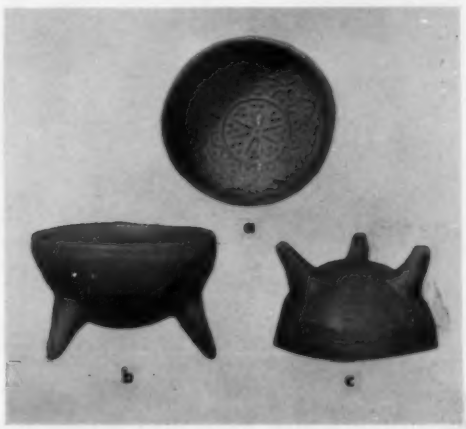

FIG. 6. Grinding bowl (*molcajete*) from Acatlán.

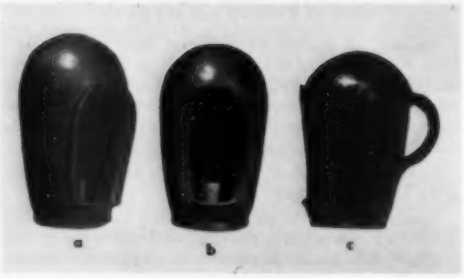

Fig. 7. Bull's-eye lantern from Acatlán.

Toro. A bull (Fig. 5 *a*). Some bulls have human riders.

Pato. A duck (Fig. 5 *b*).

Chimbul. A much smaller variant of the *cantimplora*, averaging 27 cm. in height (Fig. 5 *c*).

Molcajete. A tripod grinding bowl with distinctively long legs, made over a mold with deep incisions so the interior bottom of the vessel stands out in bas-relief (Fig. 6).

Farol. A bull's-eye lantern to hold a candle, 26 cm. in height (Fig. 7).

Apaxtle. A cooking casserole.

Cajete. A small bowl.

Olla. A globular cooking pot.

Pottery production is organized on the basis of the family workshop. Most potters buy the basic gray clay from professional "miners" who bring it by truck from deposits 5 km. away and sell it at 100 pesos a load. Sand temper is found in a deposit scarcely a kilometer away, and since much less is needed, families bring it on burro-back to their workshops. Some potters sieve and mix the two ingredients dry; Herón puts the gray clay in a large *apaxtle* with water, and sieves the sand into it, mixing as he goes. Varying amounts of temper are used, depending on the quality of each load of clay.

The *parador* is used in two distinct ways. *Apaxtles* and more elaborate forms derived from this basic shape are built up with successive annular rings of paste. The other vessels are made over molds, and then finished by hand. A single mold sometimes serves as base for several different final products: for example, the same mold may be used for a bull, a duck, and the *chimbul*. The two methods of working will be described in turn, with Herón illustrating the first, and a male cousin the second. While working, Herón sat on a tule mat under an open shed at the back of his patio, where his

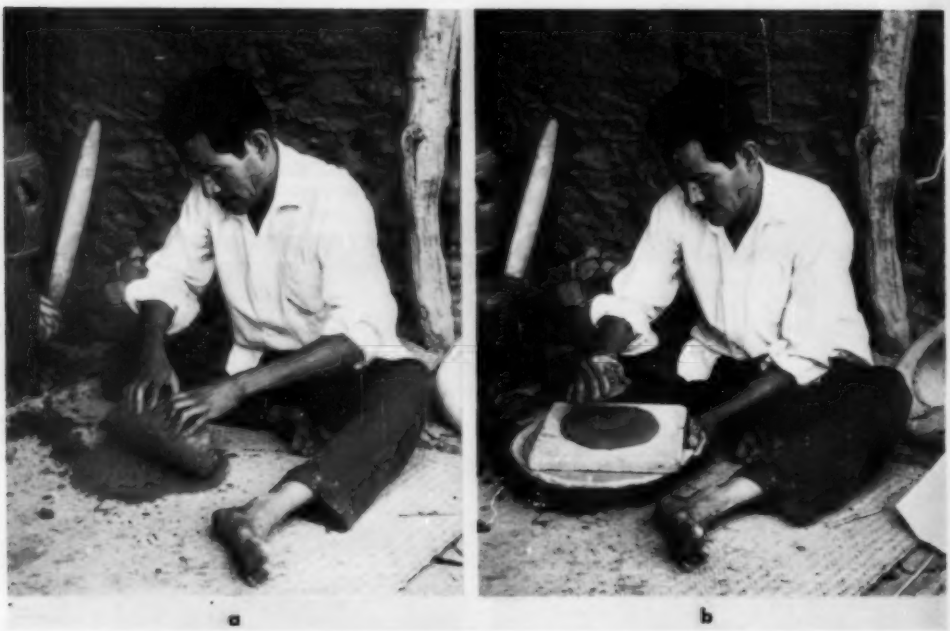

Fig. 8. Herón Martínez, Acatlán potter, beginning the making of a pot on the *parador*. *a*, kneading the paste on a mat; *b*, patting the tortilla of paste on the *ladrillo*.

wife also cooks. First he kneaded previously-mixed paste and then patted it into a tortilla on the mat (Fig. 8 *a*). The tortilla was then placed on the *ladrillo* floor tile which was placed so that its four corners barely overlapped the *parador* lip, and was further thinned and smoothed with a daub of paste which took the form of and had the function of the pottery mushroom anvil used in other parts of the world (Fig. 8 *b*). After further smoothing by hand, Herón trimmed the tortilla to a perfect circle with a compass, a modern touch doubtless due to the demands of a tourist market. Next he rolled a rather thick, heavy fillet on the mat, with which he started to build the sides, beginning at the four o'clock position as he faced the bottom.

At this point he first rotated the *parador*, pushing in a counter-clockwise direction with the ball and inside sole of his right foot, so that the fillet was pinched on in a clockwise direction (Fig. 9). When the first annular ring was in place it was smoothed by hand and with the *cuchara*. During this operation the *parador* was turned in both directions alternately, both feet pushing and pulling as needed. Sometimes the bottoms of the feet, including big toes, engaged the lip of the *parador*, and sometimes they obtained a purchase on the overlapping corner of the tile (Fig. 10).

Next Herón added several more fillets to make annular rings in the same way, pinching them on the upper and outer side of the preceding ring. The technique was that of successive circular increments, and not a continuous spiral. Then he took a rough corncob to smooth, pull up, and thin the sides, rolling it toward himself at a 45° angle as he worked (Fig. 11). Next the topmost ring was added (Fig. 12), and then the last smoothing was done, first with the rough corncob and hands, and then with the smooth corncob, the *carrizo* knife, and the wet rag. This operation completed an *apaxtle* (this specimen subsequently was turned into a swan dish by the addition of a long, graceful neck, a head, and wings).

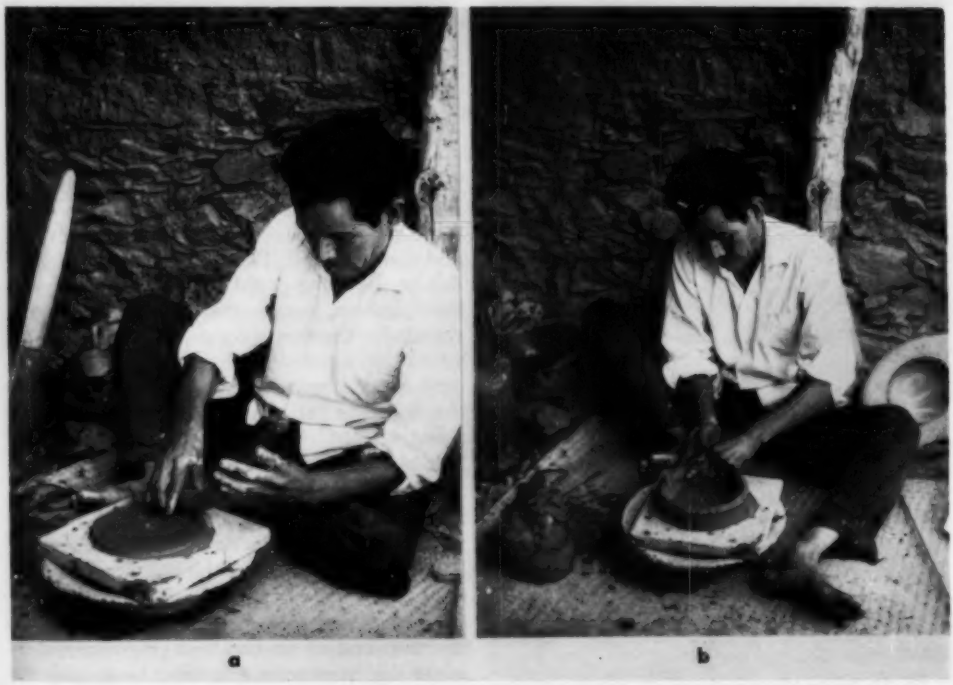

FIG. 9. Herón Martínez building the vessel wall on the *parador*. *a*, adding a thick fillet on the base; *b*, pinching the annular segment in place.

The term "revolutions" is meaningless in describing the turning of the *parador*. The average rotation was a quarter turn, determined by the foot working against one of the four tile corners. Often several of these quarter turns followed each other in quick succession, but with equal frequency Herón would make a single turn, work for several seconds, and then make a second and a third turn with the same long intervals. All male potters use *paradores* (and molds) Herón said, but less than half of them turn them with their feet. Women also use the *parador* as well as small molds, but they never turn with their feet because of the "awkward" (indecent) position it requires. Figure 13 illustrates the method by which women use the *parador* for ring-building. All turning is done with the hands.

In making a pot by the second technique, Herón's cousin patted a tortilla of paste on the mat, placed it over the bottom of an upturned mold (Fig. 14 *a*), slightly smoothed it by hand, and then patted it with the daub of paste that functions as an anvil (Fig. 14 *b*). Then he lifted the mold and placed it mouth down in a bed of sand inside the *parador* for smoothing and finishing. Next he turned the mold right-side-up so that the round bottom of the pot-in-making rested in the sand in the *parador* (Fig. 15). Here he trimmed the rough edge with a reed knife and then removed the mold. In the final operation, which was not witnessed, the shoulder, neck, and rim are finished by segmental building after the bottom half has dried sufficiently so as not to be deformed by the additional weight. This potter turned the *parador* at the same speed as Herón, and in the same fashion, except that there were no tile corners for the toes to grasp. Since most molded vessels have round or slightly convex bottoms, sand offers a better base for working than does the floor tile used for flat-bottomed ring-built forms.

Fig. 11. Herón Martínez smoothing and thinning the vessel wall with a corncob.

Fig. 10. Herón Martínez turning the *parador* with his feet and showing the use of the big toe in obtaining purchase on the overlapping corner of the *ladrillo*.

It should be noted that the Acatlán mold work is almost identical to that of Cuernavaca, Morelos, except that in the latter city a simple wheel replaces the *parador* (Foster 1955: 14–15). The implications of this will be mentioned in a moment.

The traditional Acatlán color finishes are a dull rust and an uneven lead gray obtained by a red slip, sometimes enlivened by sparing use of white slip design elements. Recently black ware has been made in imitation of Coyotepec.

FIG. 12. Herón Martínez adding the topmost ring to the vessel wall. *a*, adding the annular fillet; *b*, pinching it into place.

Kilns are simpler than those commonly used in other parts of Mexico. Herón's, which is typical, is circular, 1.5 m. in diameter, built of flat stones held together with mud. It has three firebox doors (*troneras*) at ground level, and lacks the usual grate that separates the combustion chamber from the pots. When the kiln is loaded a 20 cm. space is left around the inside wall. *Jiotillo*, a resinous organ cactus, is used for firing, and the stalks are fed into this space, so that flames surround the pots. For black ware Herón fires three hours, then stops the firebox doors with mud, and seals the potsherds that cover the kiln so that the oxygen content of the kiln is reduced. For a lead color the same amount of fuel is burned, but the kiln is not stopped. For the rust finish, only three-fourths as much fuel is used, and the kiln is not stopped. Herón says that all ware has the same red slip, and that final color differences are due to the method of firing.

As in other Mexican villages, progressive potters are experimenting with new designs and colors. These include, in addition to the black color, handsome candlesticks (Fig. 16 *c*), tripod bowls of archaeological form (Fig. 16 b), virgins, swans, fish, lighting fixtures, and lamp bases. Herón shares the common reticence of Mexican potters to tell the origin of new colors and models. He says he began experimenting with black about 1955, hit upon the oxygen reduction technique, but couldn't perfect it. Then the well-known Oaxaca sculpture and popular arts dealer, Cleotilde Schondube, gave him suggestions for doing better work. Cirilo Juárez is said by other potters to have introduced the black ware, but to this Herón replies, "One of my nephews betrayed me and took Cirilo the technique." Regardless of where truth lies, the tourist market stimulus through

FIG. 13. Method by which Acatlán women use the hand-turned *parador* for ring-building pottery.

Fig. 14. Making a vessel over a mold at Acatlán. *a*, placing the tortilla of paste on the upside-down mold; *b*, patting the tortilla in place with a daub of paste which serves as an anvil.

popular art dealer intermediaries explains the recent Acatlán florescence. Herón says the well-known Puebla dealer, José Samañiego, brought him the monkey design of Coyotepec's famous Doña Rosa Real about 1957, so that he could have a supply nearer to Puebla. A recent fish design is also from Oaxaca, but Herón says the swan dish is his own creation. Diffusion is rapidly wiping out many Mexican regional distinctions. Although as yet uncopied, I noted in Herón's workshop a Patamban (Michoacán) rabbit design plate, a black glaze plate with a white fish design from Tzintzuntzan, made by Bernardo Zaldivar, and a white Tzintzuntzan plate, probably made by Guillermo Morales.

Acatlán techniques have diffused to two nearby villages, according to Herón. Eight or ten potters in Tehuitzingo, Puebla (a few miles north on the main highway), and two or three in Piaxtla (several miles southwest) now use Acatlán methods. Otherwise the only reported comparable contemporary Mexican technique is that of Mama, Yucatán.

The evidence for the possible antiquity of the *kabal-parador* technique comes from Drucker, Heizer, and Squier (1959). They illustrate vessels (Pls. 57, 59) from Offerings 20 and 21 which are very similar in shape to the *kabal-parador*. These are post-Phase IV, certainly from the Christian era, and possibly post-Spanish, as suggested by a vessel from Offering 26 (Pl. 58) which subsequent to publication has been identified by John Goggin as a Spanish olive jar.

Through the courtesy of the United States National Museum I have been sent specimen No. 423074, similar to those of Plates 57 and 59 of the La Venta monograph. Although not illustrated, this is described by the authors as Crude Reddish-buff ware; it is very friable and poorly fired. These characteristics, and the absence of bottom abrasions, show that it was never used as a *kabal*. This evidence is not conclusive, however, since the vessel appears never to have been used for anything, and was apparently made as one of a series of cere-

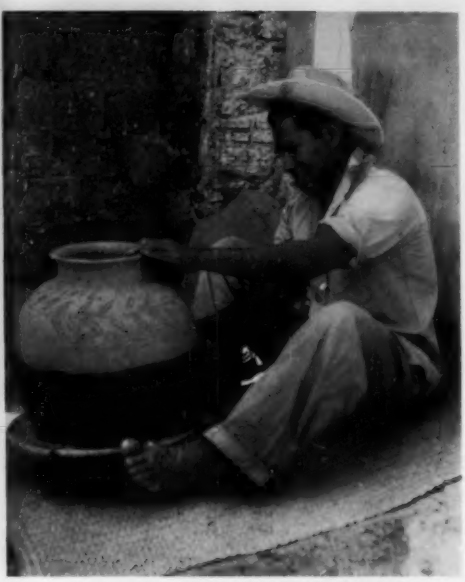

FIG. 15. Mold and partially-made pot placed right-side-up in a *parador* filled with sand preparatory to trimming the edge of the paste and removing the mold.

monial offerings. Specimen No. 423067 from Offering 19 is more significant. It is a casserole-like vessel with flaring sides 32 cm. in diameter at the rim, and 6 cm. high. The authors of the La Venta report describe it as White-Rimmed Coarse Black ware, and illustrated it in cross section (Fig. 42 *b*, p. 165). This vessel was recovered in pieces, and in reconstruction it was glued to a cardboard base, thereby partially obliterating the significant evidence. Removal of the cardboard reveals beyond reasonable doubt a heavily abraded bottom. My colleagues, R. F. Heizer and J. H. Rowe, agree with me that the degree of wear seems far greater than a vessel normally would develop in kitchen use. Since the size, shape, and weight of this specimen are within the normal range of *kabal-parador* mobile bases, it may have been used for a similar purpose. This possibility is strengthened by the fact that La Venta is the approximate center of a large area in which some variant of a mobile base is the most common pottery making technique used today, and by the fact that none of the modern mobile bases is Spanish in origin. In old-fashioned terms, we seem to have a good example of the age-area hypothesis. To the east the *kabal* is the only surviving pottery-making technique. To the west, if we assume diffusion for the *parador*, the mobile base technique came into contact with the aboriginal mold area of Central Mexico, and the two techniques were combined. Therefore, in Acatlán the *parador*-and-annular-ring method of building would represent the older technique, while the *parador*-and-mold method represents a hybrid technique, just as the Cuernavaca wheel-and-mold technique is a hybrid, with the wheel substituting for the *parador*.

The evidence is not sufficient to prove the antiquity of the *kabal-parador*, but it does suggest the distinct possibility. If archaeologists are aware of the problem, and know what to look for, it should not be difficult to prove or disprove this hypothesis, as the case may be. The information in this report should also make the point that greater familiarity with contemporary pottery techniques in general will sharpen the archaeologist's awareness of critical data which now go unrecognized.

FIG. 16. Black ware of Oaxaca type made at Acatlán as a result of the stimulus of the tourist market. *a*, tripod bowl; *b*, tripod bowl of an archaeological form; *c*, candlestick.

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University of California
Berkeley, Calif.
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AGRICULTURE AND THE THEOCRATIC STATE IN LOWLAND SOUTHEASTERN MEXICO

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ABSTRACT

Shifting cultivation, which is the technique commonly followed by tropical agriculturists, while wasteful of land use in requiring a long fallowing period, will support variable population densities depending upon crops grown, farming tools used, and soil fertility. Twenty persons per square kilometer is accepted as the density for the region around the Preclassic La Venta site which was begun about 800 B.C. and abandoned about 400 B.C. The occupation area of the La Venta culture group is believed to lie between the Coatzacoalcos and Tonalá rivers and amounts to about 900 square kilometers, thus yielding a population figure of about 18,000, of which 3600 are family heads. The total man-days of labor required to build the La Venta site is estimated to be 1,100,000, and the four major rebuildings of the site features are suggested as having been done at completion of 52 and 104 year calendar rounds.

THIS ARTICLE summarizes the procedures involved in the specialized system of cultivation practiced in the Mexican Gulf lowland tropics and concludes that this agricultural method provided sufficient economic support and surplus to make it possible for the theocratic or religious state to develop. The illustration chosen for the Preclassic theocratic state is one of the earliest of the great ceremonial centers of Mexico, that one called La Venta, which was built in the lowland jungles of southeastern Mexico early in the first millennium before Christ.

It is generally believed that New World higher civilization is a local, indigenous development (Willey 1960), that the inventions of plant domestication, complex religions, exact calendars, pottery-making, monumental sculpture, architecture, hieroglyphic writing, true-loom weaving, metallurgy, and the like, which might be called the aspects of high or advanced culture or civilization, were inventions made in America by American Indians.

The invention of agriculture constituted the first major revolution in man's existence, since it provided for a significantly large segment of humanity a means of economic security, settled life, production of surplus foods, and heavier populations which had more free time available which might be diverted into non-subsistence activities, and from which could develop specialization of skills (Boas 1912; Childe 1946; Kroeber 1923; 1948: 690). Eric Wolf, in his recent book on Mexico (1959: 51), says that agriculture

> was certainly a major step in giving man greater control of his environment, toward making him its master rather than its slave. For a hunter and gatherer of wild food is a slave to his food supply; if his game or wild food crop is abundant, he may live the life of a savage Riley; if it decreases or vanishes, he may face extinction with it. In controlling the growth and maturation of plants . . . man still makes use of natural processes. But [in his role as a farmer] he assumes some of the functions of nature herself, replacing the natural controls over plant maturation and growth with his own.

Precisely when and where maize, or corn, the main food plant of the North American Indian farmers, was first domesticated is not yet known. Archaeologists have recovered in the dry deposits of Bat Cave in New Mexico and La Perra Cave in Tamaulipas in northeastern Mexico a very primitive form of cultivated corn. The Bat Cave corn is dated at 3600 B.C. and the La Perra Cave corn at 2500 B.C. Analysis of the food refuse in the dry cave of La Perra enabled MacNeish, who performed the excavation, to compute that the diet of the cave occupants of 4500 years ago consisted of 76% wild plant foods, 15% animal food, and 9% cultivated plants, thus providing an economic picture of a hunting and gathering people who were only just beginning to practice farming (MacNeish 1958). By 1500 B.C., about 1000 years later, the same area of Tamaulipas was fully settled by village farmers. Since the oldest known occurrence of cultivated maize in Peru dates from about 700 B.C., it is assumed that the maize plant diffused southward through Central America to western South America. Future research will perhaps answer the question of whether maize might have first developed genetically from its wild ancestor in southern Middle America (Willey 1960: 81) and then diffused to the north into the southwestern and eastern United States, and to the south into South America, or whether its original home lay somewhat farther north (MacNeish 1958).

Although we have no direct evidence of corn in the form of cobs or seeds, it can be stated with practical certainty that maize was being grown (presumably by the slash-and-burn

method) in the tropical forest lowlands of southeastern Mexico by 900 or 1000 B.C. A. V. Kidder (1940: 121) has suggested that maize growing in lowland Mexico was preceded by the South American type of tropical agriculture derived from the Amazon-Orinoco region, with the starchy root called manioc as the main cultivated plant (compare Willey 1960: 82). For this theory there is, however, no evidence, and the oldest archaeological remains of settled farmers in lowland Mexico indicate, by the presence of metates, that maize was being grown. Kidder's proposed pre-maize farming complex is analogous to the "vegeculture" stage which precedes true field agriculture in the economic series suggested by Braidwood and Reed (1957: 21–2).

The tropics have been defined by Gourou (1956: 336) as the area of the earth where the average of the coldest month does not descend below 18° C., where the yearly total rainfall is greater than 750 mm., and where agriculture is possible without irrigation. This definition is a special one, and is particularly suited to our present inquiry. The agricultural potential of the tropical portions of the earth is variable, since the efficiency of exploitation depends in part upon variable cultural factors such as tools available for cutting the forest, implements for weeding fields, as well as the agricultural system employed and the crop plants, such as maize, rice, or rootcrops like manioc or taro, which are grown. Thus tropical Asia comprises eight million square kilometers and holds 650 million people, whereas the rest of the earth's tropical regions encompass 30 million square kilometers and hold only 190 million people.

There is one method of cultivation which is best suited to hand-farming (digging-stick or hoe-agriculture) in the tropical forest. This method has various names (Bartlett 1956: 693), the most common being "shifting cultivation" and "slash-and-burn." See Bartlett (1956: 704–8) for a discussion of how permanent cultivation can develop in tropical forest areas. For an exhaustive bibliography of published references on shifting cultivation see Conklin (1959b). In Mexico shifting cultivation is usually called the "milpa" system; for good descriptions of the system see Cook (1921), Lundell (1937), and Steggerda (1941).

A field is measured off in the standing forest and the woody vegetation consisting of trees, shrubs, and vines is cut down, stacked in piles, allowed to dry, and then burned. All this is done according to a strictly observed calendar — for example, the woody plants are most easily cut in the rainy season when they are full of sap, and the slash must have time to dry in order to burn up completely. The best drying occurs in the hottest part of the year which just precedes the onset of the rainy season, and the planting of the maize seeds should come just before or with the first rains. Thus, a miscalculation in timing of even as little as a week in the performance of any of these necessary acts may prevent the jungle farmer from realizing a crop with which to feed himself and his family. A field carved out of the jungle with such effort can grow only one, or at most two, crops. That is, after one or two years a field is abandoned to revert to natural growth and only after an extended time, which may be called the fallowing period, is it again cleared for a milpa.

Computations have been made of the amount of land which a family needs in order to support itself by annual or biennial clearing of a field of a certain size while at the same time observing the proper fallowing period. The modern Totonac of central Veracruz require 19 acres to support a family of five under their system of land rotation which employs a fallowing period of 12 years. The Maya of the village of Chan Kom need 35 acres of land to support a family of five, the fallowing period here being seven years. At Chichén Itzá in Yucatán the modern Maya require 59 acres to support a family of five. Such figures could be cited for many tropical Mexican groups, but this is unnecessary because it is clear from those given that the total amount of land needed to support a family varies, and that where the amount of land is small the yield is large and where the amount of land is large the yield is relatively less. If the land is not very productive and the fallowing period is long, the result is a low density of population. Population density estimates run from 7 to 30 persons per square kilometer in the Yucatán peninsula and lowland Maya area of the department of Petén of Guatemala (Termer 1951: 105; Hester 1953: 290). Twenty persons per square kilometer has been suggested as the density figure for the southern part of the state of Veracruz (Sanders 1953: 51; compare Foster 1942: 4–5).

So long as there are not too many people trying to support themselves off a given amount of land, the agricultural system of shifting culti-

vation by the slash-and-burn technique will be a successful one. But, as Cook (1921: 310) pointed out 40 years ago, if the land is cleared and burned too frequently, the trees and other woody vegetation may be killed off and the land become subject to erosion or covered with tough grass which cannot be farmed with the simple tools possessed by American Indians. It is also noted that the bush takes longer to renew itself after each cutting and burning, and this is attributed to the decreasing soil fertility. The clearing of fields by fire apparently has a long-term effect of reducing the soil fertility by burning out the humus which is converted to soluble mineral salts in the form of ash which percolate through the thin soil and thus is lost (Hester 1953: 291; Cook 1921: 314). The first year milpa has some weeds and suckers or shoots which come up from the stubs and roots of the cut-off trees. In the second year, even though the field has been cut and burned over again, the corn plants face severe competition from the forest growth and the yield is usually 20–25% less than the first year's crop. If the roots are dug out to clear the field, grass takes over (Kelly and Palerm 1952: 102, 114, 149; Cook 1921; Sanders 1953: 64), so it is on the whole easier, and an adequate maize crop is more assured, if a new milpa is cleared from land which has lain fallow for eight or ten or 12 years.

The demographic effects of the milpa system have been aptly termed "centrifugal" (La Farge and Byers 1931: 70; Wolf 1959: 60) since its lavish use of land inhibits population concentrations and encourages mobility and scattering of people. Let a village of 200 or 300 persons increase to 400 or 500, and there is pressure for conveniently located farm land. In Guatemala and Yucatán fields may be 20 to 30 miles away from a man's home (Cook 1921: 315; Steggerda 1941: 125) and in this situation the inevitable result is the formation of a daughter or offshoot colony some distance away where land is available. When the available free land becomes scarce and the population pressure continues to increase, the unavoidable result is to upset the delicate ecological balance between man and his environment in terms of the agricultural system. The dangers of over-use of land by too frequent clearing and burning will lead to declining production through decreasing soil fertility and invasion of grass, with the final result that the land cannot support the population (Palerm 1955: 28–9). (For a most interesting suggestion on a method of calculating critical population limits under a tropical forest agricultural economy, see Conklin 1959a.) This is one widely held view to account for the abandonment (Willey 1956: 113), about A.D. 900, of the great southern Maya cities and ceremonial centers of lowland Guatemala (Wolf 1959: 273–4; Cook 1921; Ferdon 1959: 13–17).

The amount of time required to clear a field by cutting the bush, drying the slash, burning, planting the crop, weeding the field, and harvesting the maize also varies from region to region in tropical Mexico. The Totonac of central Veracruz need 133 days to produce a crop; in Yucatán 190 days of labor will produce 168 bushels of shelled corn, of which only 64 are needed to support a family of five. The 104 bushels raised but not eaten are sold. The modern Indian group at La Venta on the Veracruz-Tabasco border needs 120 days to produce 150 bushels of maize, but a family of five requires only 100 bushels for food. In each case, only part of the year is expended in agricultural labor, and this expenditure of time produces not only sufficient maize for minimum dietary needs, but a surplus as well. In ancient times some portion of the extra time available, which might range from five to eight months per year, would have been usable for other than subsistence activities.

Over large parts of Mesoamerica, by which I mean here the area extending from central Mexico southward to Honduras, the early part of the first millennium before Christ saw the transition of simple village farmers into regionally organized groups who were under the influence of a special priesthood whose operations were performed at religious or ceremonial centers. These centers are the sites of the oldest large-scale architectural constructions in Mexico, and in general are characterized by arrangements of mounds or pyramids, and plazas. (For discussion of Preclassic platform mounds, see Drucker, Heizer, and Squier 1959: 261; Wauchope 1950; Willey 1955: 573, 582–83; Lowe 1959: 11). In highland Guatemala there was such an early ceremonial center at Kaminaljuyú by 400 B.C.; the occupants of the Valley of Mexico were building similar centers at about the same time or slightly later. The oldest known such ceremonial center, and it is a large and impressive one, is the Olmec culture site of La Venta in northern Tabasco which

was built about 800 B.C. La Venta is too large and elaborate a site to be the first of its kind, and although it is the most ancient ceremonial site of its size and complexity known at present in Mexico, there must surely be older and simpler ones yet to be found and excavated.

The La Venta site lies on a small island comprising 2.1 square miles of dry land in the sea-level coastal swamp area of northern Tabasco, on the right bank of the Tonalá River, which, 18 miles below the site, empties into the Gulf of Campeche. The Tonalá River forms the boundary of the state of Veracruz to the north and Tabasco to the south. Heavy tropical forest covers the area except where there are wet swamps. The land is flat, low-lying, and without stone outcrops since these lie deeply buried under alluvial sands and clays. The annual rainfall amounts to about 120 inches per year, and there is one main dry season of about four months which begins in February and ends in late May. The La Venta site (Drucker 1952; Heizer 1957; Drucker, Heizer, and Squier 1959) consists of a linear complex of constructions made of heaped-up clay, the alignment of the site being 8° west of true north, with main mounds bisected by the centerline and secondary ones lying equidistant on either side of the line.

The site is about half a mile long, but only in its northern half is there a concentration of structures. First, proceeding from south to north, comes the great pyramid which is a flat-topped clay construction measuring 240 by 420 feet at the base and standing 110 feet high. Then come two long, low mounds on either side of the centerline, a low mound in the center, a rectangular open court or plaza surrounded by a wall of stone columns set side by side in the top of a low adobe brick wall, and finally, along the centerline at the far north, a large terraced clay mound. Scattered about in the central complex just described, as well as to the north and to the south of the pyramid, are many large stone monuments, some of them weighing 40 tons. These are flat-topped altars, great stelae or flat-surfaced stone slabs with ornate sculpture on one face, five of the famous colossal heads which stand 7–8 feet high, and a score of minor sculptures. Covered now with heavy jungle, this dead religious center which was abandoned 23 centuries ago is still impressive. Nine radiocarbon dates show that the site was built about 800 B.C. and abandoned about 400 B.C. (Drucker, Heizer, and Squier 1957).

The original site plan was maintained faithfully through three major rebuildings when mound and pyramid structures were enlarged, the court floor was successively raised, and monuments were relocated. The average span of time between each construction phase was, therefore, about one hundred years, and in view of the common practice in Mesoamerica of periodic enlargement of ceremonial structures, we may assume that a regular, rather than accidental periodicity of refurbishing is thus evidenced. The so-called Maya calendar system appears among the Maya in fully developed form about A.D. 300, but older dates inscribed on Olmec monuments are known, and most authorities now attribute to the Olmec of southern Veracruz the invention of this time-reckoning system (Coe 1957; Stirling 1940; Thompson 1954: 50, 158). Various time cycles, notably the 20-day month, a 260-day period, the 365-day solar year, and the 584-day Venus year were all correlated so that grand revolutions, at which time great ceremonies were performed, fell in cycles of 52 and 104 years (Thompson 1950, 1954: 137–59). If the La Venta group did observe the 52- and 104-year calendar rounds, as seems highly probable, but thus far unproved (Thompson 1950: 5), we may have here some hint as to the time span separating each of the series of rebuilding phases of the La Venta site.

The ceremonial or ritual nature of the site is obvious. It is surely not a city where large numbers of people lived. A recent study of the modern agricultural system practiced by natives on La Venta island (Drucker and Heizer 1960) shows that not more than 150 persons can support themselves here under slash-and-burn farming of maize, so that a large, self-supporting resident population on the island is not possible. No living trash or occupation refuse occurs in the main site area. There are some refuse deposits scattered about around the borders of the site, and these, we believe, are the trash heaps of the priests and attendants who lived here and performed the ritual activities at the religious metropolis.

The isolated position of the island of La Venta and its religious center by that name clearly indicate that it is a detached center occupied by a corps of priests and attendants, and that it was built and economically supported by a population living some distance away. This supporting population did not live to the east,

where there is only a vast stretch of low, swampy ground unsuitable for occupation and farming. To the west, between the Tonalá and Coatzacoalcos rivers, is an area of low hills which amounts in aggregate to some 900 square kilometers (about 350 square miles), and which forms a unitary topographic region lying between the two great rivers (Fig. 1). This area seems a likely one for a small, politically organized group to occupy, and is strategically so situated that the La Venta site may have been its vital center (compare Sanders 1953: 59). While we do not know the present number of peasant farmers in this area, it is known that there occur here a large number of small population concentrations, some of which run to 300 or 400 persons. Local settlements dating from the La Venta period are known to occur in this area, but their size, number, and distribution remain to be determined. It may be supposed that each such local grouping had its own shrine, and an indication, however slight, of such local ritual centers may be seen in the isolated classic Olmec sculpture reported by Nomland (1932) from Arroyo Sonso (the present village of Moloacán). The village of Moloacán, incidentally is comprised of 60 families, of which 15 live in the central *ranchería* and the rest are scattered about in and on the edges of the small valley.

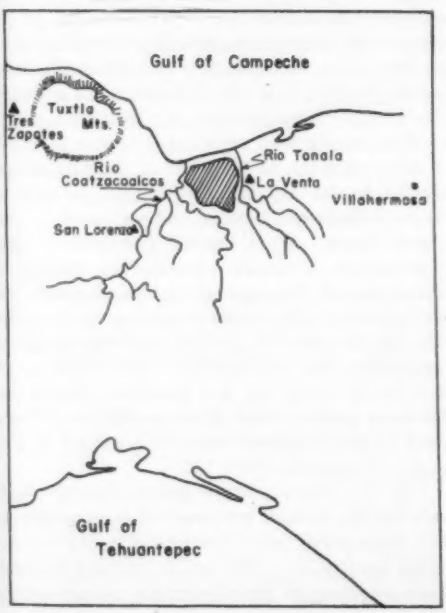

FIG. 1. Location of the three main Olmec sites. Hatched area is suggested occupation region of the La Venta population.

If we accept the figure of 20 persons per square kilometer as the aboriginal density, this area would hold a population of 18,000 persons. Let us now, having assumed that the La Venta ceremonial center served as the religious, and probably administrative, center of a dispersed village population living in the elevated section between the two rivers, inquire into the possibility that a population of 18,000 could have built and maintained the center over a period of 400 years. If we assume a nuclear family of five, there would be 3600 able-bodied male family heads.* Careful calculations have been made of the number of men which would be needed to excavate and refill each of the large offering pits in the La Venta site, and these run between 120 and 300, on the assumption that the work day was 8 hours and the work period was 100 days. The pyramid, which contains 4,700,000 cubic feet of earth, would require 800,000 man-days to construct. Extrapolating from the few examples where we have some basis for believing that we can secure time and labor figures of the proper order of magnitude, to the man-days of labor needed to build all of the constructions in the site and import the stones for monuments and columns, we get a grand total of 1,100,000 man-days. To satisfy this requirement, only 25 man-days per year for 400 years would be needed, but archaeological information tells us that the work was not carried out by yearly bits, but in at least four major efforts. Since the dry season of about 100 days maximum is the only convenient period for such earth-moving activity, the total man-days required would have been 275,000 per year for four years, or 2750 per day for the 100-day work period for each of the four years. But we cannot assume that the great pyramid, with a mass of nearly five million cubic feet of earth, was built in four stages, and it is proposed that at the end of every 50-year calendar round the pyramid was added to, and that every 100

* Since this paper was written the important work of S. F. Cook and W. Borah (The Indian Population of Central Mexico, 1531–1610, *Ibero-Americana*, No. 44, Berkeley, 1960) has appeared. Their figure (p. 38) for average family size is 3.3 persons, and I accept it as more accurate than my estimate of 5 persons. Using the 3.3 figure there would be 5450 family heads.

years the other mound constructions to the north of the pyramid were rebuilt.

Let us, therefore, separate the construction of the pyramid from the rebuildings of the mounds and ceremonial court or plaza to the north. When we do this, we note that the pyramid, which requires, in round numbers, 800,000 man-days of labor, could be built in eight 100-day work periods. The labor requirement for each of the eight work periods is 100,000 man-days, or 1000 men working for 100 days. The mound rebuildings and court refurbishing, plus procurement of the stones for the monuments, come to an estimated 300,000 man-days. With a 100-year cycle, four work periods of 100 days each would require 75,000 man-days per year or 750 men working for 100 days. Thus, every 50 years 1000 men would be put to work on the pyramid, and every 100 years the work crew would expand to a total of 1750 to work on the pyramid and the mounds and court area to the north, a number which comes to only one-half of our estimated available labor force of 3600 family heads. If the period of labor service was fixed at two 20-day months, two work gangs of 875 men, each devoting two months of 20 days to the service of the gods, could have done the job.

While these figures are crude estimates, they are nonetheless based in each case upon how much earth a man can dig and carry, and upon time-reckoning periods which we have reason to believe the Olmecs knew (Thompson 1950, 1954) and upon which they conducted their affairs. In other words, while I do not believe the figures are accurate in that this is how the Olmec of 2500 years ago actually planned their work, nevertheless it is reasonable to believe that this is how they may have done it. And even more to the point of the present problem, if the Olmec of this ancient date had practiced slash-and-burn maize agriculture, they would have possessed the free time and economic surplus to carry out the work which I have outlined above. While admitting that I have not explained why the theocratic state came into being, I have at least shown the means by which this development was permitted to exist.

As to why the La Venta site was abandoned after 400 years of use, we have no clear evidence and are forced, therefore, to rely upon speculation. It is perfectly possible that when the site was first built the intention was that it should serve its function for a predetermined span of time, such as eight 50-year periods or four 100-year cycles. Or, the people and the site and its priests may have been conquered by an invading group of another religious persuasion. If the La Venta culture group lived in peace and flourished, they may have expanded their numbers to the point of overpopulation, which placed undue pressures on the land through frequent clearing so that economic suicide became inevitable through decreasing production and increasing demands. Or, if the spiritual and temporal power of the priests increased during their four centuries of control, there may have come a point beyond which the common people refused to go to meet the intolerably heavy demands for their services and time. A bare suggestion of this in the La Venta site is the occurrence in its final phase of large tombs which might be interpreted as the ultimate development of class differences evidenced in the burial of high priests within the ceremonial area (Drucker, Heizer, and Squier 1959: 127). A mutilation of 24 of the 40 sculptured monuments at the La Venta site indicates some religious reaction. The mutilation varies from battering off the heads of sculptures, or the despoiling of the facial features of priests or deities portrayed on stelae or altars, to the outright destruction of whole monuments whose remains now comprise only fragments bearing bits of sculpture. One could interpret such evidence as due either to a succeeding people who were engaged in a program of destroying the religious art of their predecessors, or to the reaction against the old religion by a disillusioned people imbued with iconoclastic fervor. A still further possibility is that a succession of natural catastrophes leading to disruption of the agricultural production system caused disillusionment among the population of the priestly leaders and the religious leadership was overthrown. No evidence of this can be cited, but it is recorded that in the 300-year period from 1535 to 1835 no fewer than 15 great famines were experienced in Yucatán (Steggerda 1941: 130).

The La Venta culture group shared, probably by the mutual processes of both receiving and dispensing, basic features of what are already recognizable, but are to become increasingly manifest as the distinctive characteristics of the Mesoamerican type of civilization (Drucker, Heizer, and Squier 1959: 258). It is because La Venta lies clearly in what Armillas

(1958: 47) has called the "gestation period" of this unique experiment in man's history, so brutally extinguished by the Spanish conquest in the 16th century, that it is of importance to the study of the growth of human culture. While the idea of the theocratic state's emergence early in the first millennium is not a new one (Wauchope 1950, 1954; Willey 1960; Wolf 1959), to date the La Venta site, by reason of its age, isolated position, and restricted population-support area, constitutes the earliest specific example of a Preclassic priest-dominated society maintaining a major ceremonial center. We may hope to learn some of the answers to the problem of how man converted himself from a hunter and gatherer to a civilized being with the advanced arts by squeezing as much interpretation as possible from ancient archaeological sites and by judging the prehistoric data in the light of what we know to have developed later, a method which Bernard Berenson, an art historian, spoke of as the "sense of antecedent probability" in dating and attributing a painting to a certain artist. The anthropologist A. L. Kroeber (1948: 148) refers to the intellectual training of anthropology as consisting of "learning to discriminate between better and worse judgments and better or worse evidence." The present attempt to blend fact and hypothesis is such an exercise in judgment based upon evidence.

ARMILLAS, PEDRO

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THE CLAYPOOL SITE: A CODY COMPLEX SITE IN NORTHEASTERN COLORADO

HERBERT W. DICK AND BERT MOUNTAIN

ABSTRACT

Eden and Scottsbluff points and Cody knives were found in situ in a sand deposit with an estimated geological age of 10,000 to 7000 years. Numerous other Cody complex artifacts from the surface of the site are described. Fragmentary remains of a mammoth in a marl bed are stratigraphically older than the Cody artifacts.

THE CLAYPOOL site is the first stratified Cody complex site excavated in eastern Colorado. It is situated in what now appears to be a regionally central occupation area for the hunters who made the Cody complex points. It was no accident that these points were originally called "Yuma" points by E. B. Renaud, for the bulk of the earlier study collections came from nearby Yuma County. Local collectors, Perry and Harold Anderson of Yuma, Colorado, were largely responsible for first bringing these collections to the attention of scientists (Wormington 1957: 104). Northeastern Colorado, especially the Sand Hill region in Washington and Yuma counties, has long been and continues to be popular with collectors. It is not uncommon to meet an enthusiastic amateur whose collection contains from several dozen to several hundred parallel flaked and related types of points. Perry Anderson and his son, Harold, actively collected from the Claypool site (which they labeled Site 64 in their records) for several years. They showed the site to Bert Mountain in 1934. After the Anderson's interest in the site waned, Mountain continued to visit it periodically until 1953 when he reported the site to the University of Colorado Museum. The excavations reported here were carried out in June and July, 1953. The excavated artifacts and the documented Mountain collection of surface finds are described and the specimens in the Anderson collection are enumerated.

The most distinctive artifact from the Claypool site is the informally named Cody knife. The first examples of this artifact were found at the site by Harold Anderson in 1935. Mountain and Anderson properly identified them as hafted knives and used that term. These artifacts are quite similar to those found by Glenn L. Jepsen at the Horner site near Cody, Wyoming (Wormington 1957: 128).

A brief but notable attempt at determining the stratigraphic relationships of artifacts in Yuma County was made by Paul H. Gebhard (1949) in 1941. Unfortunately he was unable to complete the projected study. A part of Gebhard's (1949: 143) conclusions was that a careful study coupled with extensive excavation might permit the compilation of a stratigraphic chart of soil zones. To this we agree, but we cannot agree with Gebhard's statement (1949: 136), presented first as fact and then as hypothesis, that Cody complex points are contemporaneous with the lacustrine marl and in the basal part of the sand bed immediately overlying the marl. All artifacts in situ were found above these beds.

Upon completion of excavations at the Claypool site, all diagrams and notes on the stratigraphy were turned over to Harold Malde who made a geological study of the site in 1954. The accompanying report by Malde (1960) has aided in interpreting the stratigraphic and chronological position of Cody complex points and tools in northeastern Colorado.

THE SITE

The Claypool site is located in Washington County, Colorado, 19 miles south and 4 miles east of the town of Otis (Malde 1960, Fig. 1). It is at the western edge of the sand hills in the edge of a small deflation basin which in turn is within a much larger basin which opens to the west. The basin containing the site is a typical example of what the people of the region refer to as a "blowout." Massive dunes surround the site at varying distances; some of these rise to a height of over 50 feet. Except for isolated spots, such as the Claypool site, most of the sand is secured by sage, yucca, cactus, and grass. Since the excavation in 1953, the area of the site has completely grassed over and is no longer being eroded by wind.

Despite the sandy nature of the region, it is quite suitable for ranching. Farming has at times been unsuccessfully attempted in soil patches among the dunes. The region is treeless. Surface water in the area is non-existent; all water is obtained from wells.

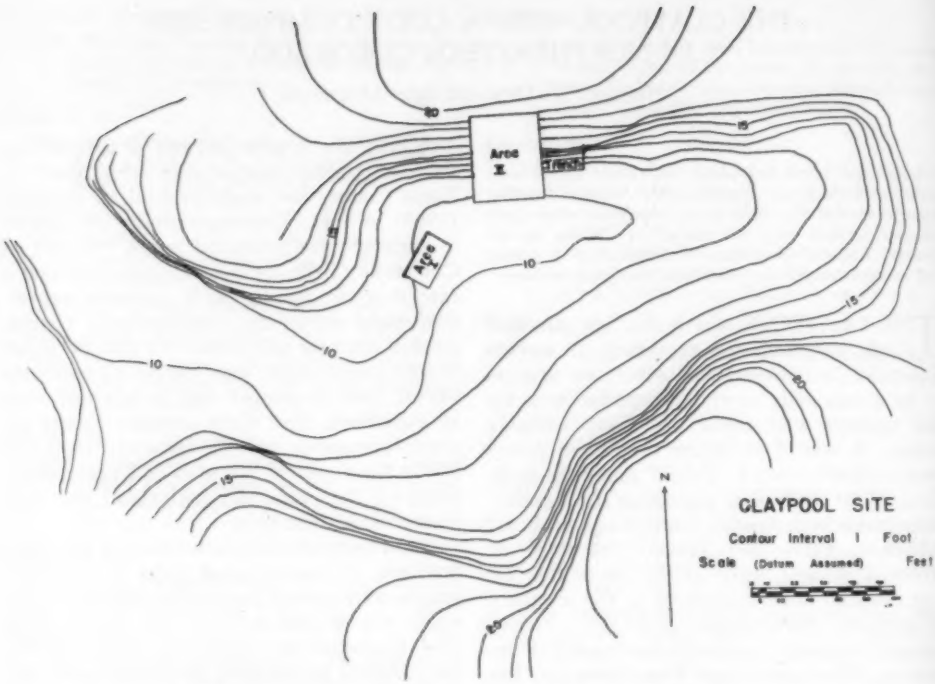

Fig. 1. Contour map of the Claypool site showing areas of excavation.

A brief summary of the present climate of the region is taken from the weather records of Akron, Colorado, 25 miles northwest of the Claypool site. The average rainfall is 18.25 inches per year. The greatest rainfall occurs during April through August. The average temperature for January is 24.7°F., for July, 73.7° (Gittings 1941: 300).

The small deflation basin containing the site measures 600 feet in length from east to west and is 340 feet wide at the west end, tapering to a width of 200 feet at the east end (Fig. 1). The floor of the basin is 14 feet below the highest elevation located at the crest of the south rim. Marl was extensively exposed in the northwest part of the basin. This bed offered resistance to wind erosion so that downward cutting was rapidly decreased. In several places in the west end marl had been cut through, exposing a light yellowish-gray sand.

Two areas in the basin were surveyed and staked for excavation (Fig. 1). Area I was a rectangular plot 20 by 30 feet located on the marl. It was sectioned in 5-foot squares for controlled excavation of the scattered remains of a young mammoth eroding out of the top of the marl. Area II was a rectangular plot 50 by 60 feet at the northwest end of the basin, also sectioned in 5-foot squares. The center of this area contained the most evidence of occupation in the form of stone chippings and fragments of burned bone. It was in the immediate vicinity that Mountain and the Andersons collected many of their Cody complex artifacts. During our first visit we found an almost complete Cody knife eroding out of the occupation sand.

All excavated sand was screened through quarter-inch hardware cloth. Levels were removed in 12-inch intervals until the dark culture-bearing sand was reached. The change of sand color from light to dark was easily recognized. Six-inch levels were removed in the culture zone. One successful method of predetermining the location of artifacts was by probing with a 12-inch surveying pin. Since the sand was free of foreign matter, other than that carried in by man, obstacles proved to be artifacts. Three points were detected in situ in this manner.

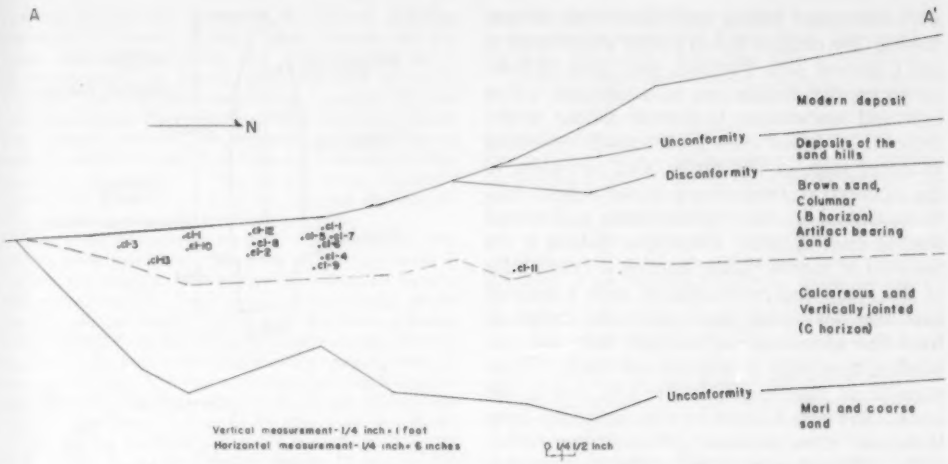

FIG. 2. Composite cross section through the deposits of Area II at the Claypool site showing location of artifacts.

AREA I: THE MAMMOTH SKELETON

The marl bed at the northwest end of the deflation basin contained the scattered, fragmentary remains of a young mammoth. The represented parts were two molar teeth, three vertebrae, one rib, one radius, one tibia, and one femur. Many of the bones had been gnawed by rodents. No artifacts were found in association with the bones. A single white chalcedony flake with a graver point on one edge was found on the surface of the marl 5 feet east of the mammoth teeth. The graver measures 45 mm. in length, 35 mm. in width and 9 mm. in thickness. It is concavo-convex in cross section. The graver is of little significance in that it could have been "let down" onto the marl from the later Cody complex sand that we presume once covered the mammoth remains. A Clovis point (M–22, Fig. 9, Table 2) was found by Mountain on the marl near the mammoth. However, this Clovis point was probably not contemporaneous with this mammoth, despite the fact that Clovis points are known to occur with mammoths, because Malde (1960) has shown that the marl deposit in which the mammoth was found is several hundred thousand years old.

AREA II: THE CODY COMPLEX

Area II, located on the north side of the basin, is 35 feet southwest of the mammoth skeleton (Fig. 1). A summary of the stratigraphy, described in detail by Malde (1960), is as follows (Fig. 2):

Modern deposit — surface

UNCONFORMITY

Deposits of the sand hills

DISCONFORMITY

Artifact-bearing sand

B horizon, Cody complex artifacts in lower half

C horizon, no artifacts

UNCONFORMITY

Marl bed, mammoth remains (intrusive Clovis point)

Basal sand

The Cody complex artifacts were uncovered in a single horizon below the deposits of the sand hills and above the marl bed (Fig. 2). Malde's studies lead him to conclude that the people occupied the site while the artifact-bearing sand was accumulating, probably under cool and dry conditions. Such conditions offer a more conducive environment for people than one that is warm and dry. The site does represent a camping location and not merely an animal "kill" site. Numerous fragments of burned bone and the hundreds of flakes along with the diversity of tools, especially those represented in the Mountain surface collection, show every indication that the people were in residence for a period of time.

DIAGNOSTIC CODY COMPLEX ARTIFACTS

Early points of the parallel flaking tradition can be divided into two broad groups, those

with horizontal flaking and those with oblique flaking. No oblique flaked points were found at the Claypool site. Further, two types of horizontal parallel flaking can be recognized, collateral and transverse. Collateral flaking is the removal of broad conchoidal spalls beginning at either edge of the blade, and extending to the midsection, producing a dorsal ridge. Artifacts formed in this manner have a diamond shaped cross section. Transverse flaking is the removal of narrow flakes, starting at either edge of the blade and proceeding in such a manner that the flake scars meet near the center to form the appearance of a single flake scar extending from edge to edge on the blade. These scars lie at right angles to the long axis of the point. Artifacts formed by this technique have lenticular cross sections (Wormington 1957: 107). Wormington (1957: 266–7) describes three distinctive artifacts for the Cody Complex. They are Scottsbluff points, Eden points, and Cody knives. All were found in the Claypool site.

Scottsbluff points. According to Wormington (1957: 267), these can be divided into two types (see Fig. 3 *a* for terminology). Type I points have somewhat triangular or parallel sided blades, small shoulders and broad stems. The flaking is usually of the transverse parallel style, but it may be more irregular. The cross section is thick oval. The stem edges are usually ground. The range in length is from 51 mm. to 127 mm., the maximum blade width about 25 mm. Type II points resemble Type I but they have wider triangular blades, are thin and lenticular in cross section, and have more clearly defined shoulders.

Eden points (Wormington 1957: 267). The Eden points resemble Scottsbluff Type I points, but are narrower relative to their length. The insets that produce the stem are very slight. Most Eden points are collaterally flaked and have pronounced median ridges and a diamond shaped cross section. In rare cases the flaking is transverse parallel and the median ridges are less clearly marked. The lengths range from 71 mm. to 155 mm., the widths, from 13 mm. to 19 mm.

Cody knives. The Horner site in northwestern Wyoming, four miles northeast of the town of Cody, is the type site for this form. It has been informally called a Cody knife, although there is virtually no published information on this diagnostic artifact (Wormington 1957: 127–8). The Cody knives favor the Cody complex point tradition in that they consist of two parts, a stem and a blade (see Fig. 3 *b* for terminology). The broken stem alone would be difficult to separate from the similar part of a Cody complex point. On the other hand, the blade shape is distinctive. If the lower edge of the blade is placed in a horizontal position, the stem forms an angle rarely exceeding 45°, and usually much less. We have called this measurement the blade/stem angle. Where the lower stem edge and lower blade edge merge there is usually a shoulder, or in some cases a notch at the junction of the stem and blade, which in some cases forms a spur. The blade is usually tranversely flaked.

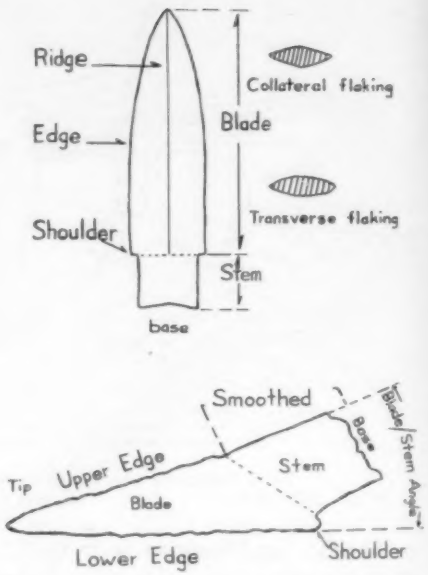

Fig. 3. Diagrams showing terminology for Eden and Scottsbluff points and the Cody knife.

Artifacts Found in Situ

Points. Fourteen points were found in situ (Fig. 4, Table 1). Nine are fully measurable; five are fragmentary and only partial measurements could be made. Eleven have been identified as Eden points, one as a Scottsbluff point (Fig. 4, Cl–11). Two cannot be typed because of their very fragmentary nature. All artifacts in the figures and tables lettered "Cl" were found in situ. The Scottsbluff point was stratigraphically the deepest artifact in the Cody complex zone (Figs. 2, 4, Cl–11). Only two points of the group are made of the same material. The stone for the points varies in texture and color; this varia-

tion has undoubtedly influenced the type of chipping. Materials are basalt, petrified wood, yellow and red jasper, moss agate, hornfels, and quartzite. The source of the material, we believe, does not offer any great problem. Gravel deposits near Akron, Colorado, 25 miles northwest of the Claypool site, contain all of the material listed above. Further, the extensive concentrations of broken stone at the gravel deposits are indicative of their popularity as a quarry, at least in later times. Hundreds of flakes of these materials in the Claypool site indicate that manufacturing was accomplished there.

One thing in common for all the points is the form of the stem and base. The base on all specimens is thinned and straight. The edges of the stems are parallel and ground smooth. Small shoulders are formed on the blade by the indentation of the stem. Excluding a miniature point, Cl–9, in the following measurements, the total lengths of the points vary considerably, ranging from 44 mm. to 144 mm. The important variation controlling the total length of the points is not in the length of the stems which range from 12 mm. to 15 mm. long, but in the lengths of the blades which range from 33 mm. to 130 mm. Range in the stem width is from 17 mm. to 19.5 mm. The measurements for the maximum blade width at the shoulder range from 18 mm. to 21.5 mm. The range of blade thickness is 5 mm. to 8 mm.; all but two points range between 7 and 8 mm. thick. The depths of the insets forming the stem range from 1 to 2.5 mm.

There are slight distinctions in the form of the blades of the Claypool points. The edges of point Cl–6 are parallel half way down from the shoulders; Cl–10 and Cl–11 parallel down one-third, and Cl–4 parallel down one-quarter. The rest of the points are tapered, forming an isosceles triangle from the shoulders to the tip. The short, stubby points Cl–4, Cl–3 and possibly Cl–9 might be rechipped specimens. There is no way of telling except by inference on the basis of the length and width of the stem, which are in the same proportion on the short specimens as on the long specimens. Points Cl–1, Cl–2, Cl–3, Cl–6, Cl–7, Cl–8, and Cl–9 are collaterally flaked, exhibit prominent medial ridges, and are diamond shaped in cross section. The flake scars on points Cl–3, Cl–6 and Cl–9 are deep and distinctive. The flake scars on the other four points are very shallow and evenly spaced.

Points Cl–4 and Cl–5 show an admixture of collateral and transverse flaking. The flakes are deep. The cross section is a modified diamond shape. Points Cl–10 and Cl–11 are transversely flaked. The flake scars are deep and wide. The cross sections are oval. Point Cl–12 is indeterminantly flaked. The cross section is a flat oval. Fine re-

TABLE 1. CODY COMPLEX POINTS FOUND IN PLACE AT THE CLAYPOOL SITE.

Figure Number	Material	Total Length (mm)	Thinned Base	Stem Length (mm)	Stem Width (mm)	Blade Length (mm)	Blade Width Max. (mm)	Maximum Thickness	Flaking	Stem Smoothed	Remarks
Cl-1	Dark gray hornfels	144*	yes	14	17	130*	18	7.5	Collateral; narrow, shallow	yes	Point tip missing; pronounced median ridge and diamond cross-section; fine retouch on blade edges
Cl-2	Light gray chalcedony with dendritic inclusions	109 ?	?	?	?	?	18?	8?	Collateral; narrow, shallow	?	Upper blade and stem missing; pronounced median ridge and diamond cross-section; fine retouching
Cl-3	Dark red jasper	47.5	yes	12	18	35.5	20	8	Collateral; wide, deep	yes	Stubby point, possibly resharpened; pronounced median ridge; diamond cross-section
Cl-4	Dark gray hornfels	53	yes	14	19	39	20.5	7	Collateral; indeterminate	yes	Stubby point, possibly resharpened; diamond cross-section tending toward oval
Cl-5	Yellow jasper	76.5*	yes	14	18	62.5	19	7	Collateral one side, transverse other	yes	Tip missing; median ridge one side, oval on other; fine retouch
Cl-6	Black basalt; quartz phenocrysts	89*	yes	15	19	74	20	8	Pronounced collateral; modified collateral on other	yes	Corner of stem and point tip missing. Diamond cross-section tending toward oval
Cl-7	Light pink chalcedony	?	?	?	?	?	?	?	Collateral	?	Point tip; diamond cross-section
Cl-8	Red mottled light brown quartzite	?	?	?	?	?	?	?	Collateral		Point tip; pronounced median ridge, diamond cross-section
Cl-9	Brown flint	51	yes	9.5	12	21.5	14	6.5	Collateral	no	Miniature point; fine retouch on one edge
Cl-10	Brown mottled gray quartzite	66	yes	14	19.5	52	21	7	Transverse	yes	Corner of stem missing; no median ridge, oval cross-section; fine retouch on edges
Cl-11	White and black lined brown flint	76.5	yes	12	19	64.5	21.5	7	Transverse; wide, deep	yes	Oval cross-section; fine retouch on edges
Cl-12	Light yellow, red mottled flint	44	yes	10	19	33	21	5	Indeterminate; wide, deep	yes	Stubby point; flat oval cross-section; corner of stem missing
Cl-13	Light gray chalcedony	?	yes	?	17 ?	?	?	?	?	yes	Portion of base, only; Thinned with long vertical flakes
Cl-14	Obsidian	?	?	?	?	?	?	?	?	?	Fragment - corner of base

* Reconstructed length.

touch flaking occurs along the edges of the blades. Interestingly, it occurs frequently on one edge and not the other, often randomly. A miniature point, Cl–9, deserves special mention (Fig. 4). It is of brown flint with all the characteristics of the larger points except for size. It is 31 mm. long and 14 mm. wide at the shoulders. The stem edges are not ground and it is not a rechipped point.

The Mountain surface collection provided missing parts to four points found in situ. In several instances the missing parts had been found on the surface ten years prior to our excavation. Mountain supplied the following parts to points found in situ: Cl–1, midsection; Cl–2, point tip; Cl–8, midsection; Cl–12, point tip. The reconstruction of portions of points found in situ from the surface material found by Mountain is more than an item of passing interest; it tends, in small measure, to help validate Mountain's collection from the surface.

Cody Knife. A single specimen, Cl–15 (Fig. 5, Table 3), of dull, dark gray hornfels was found eroding out of the artifact-bearing sand which was exposed in the lower part of Area II. It can be regarded as being in situ. A corner of the stem, a bit of shoulder and the blade tip are missing. The stem measures 19 mm. long, 22 mm. wide and 4 mm. thick. The blade, reconstructed, is 82 mm. long and 22 mm. wide at the shoulder. It is 5 mm. thick. The upper stem edge is ground a distance of 33 mm. The lower stem edge is ground 20 mm. The blade/stem angle is 18°. The blade is transversely flaked and flat oval in cross section.

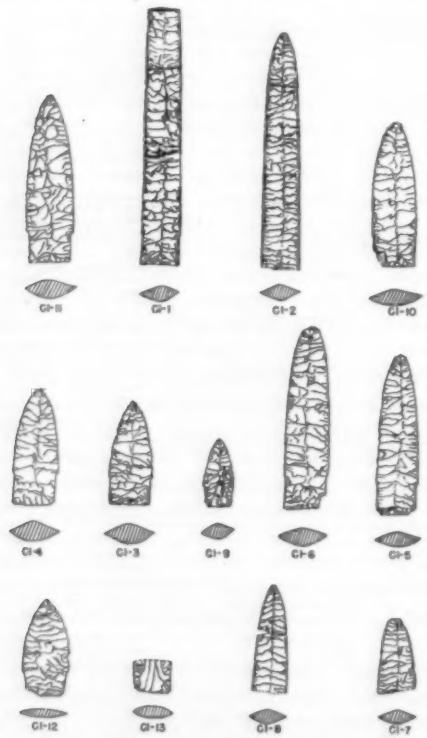

FIG. 4. Cody complex points found in place at the Claypool site.

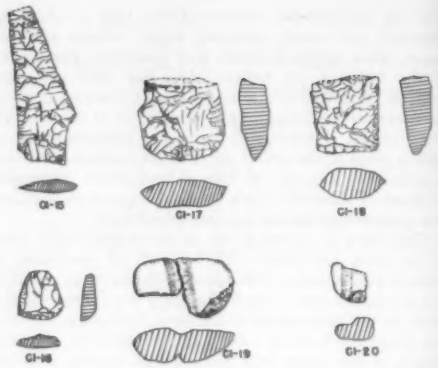

FIG. 5. Cody complex artifacts found in place at the Claypool site. Cl–15, Cody knife; Cl–16, snub-nose end scraper; Cl–17, combination side and end scraper; Cl–18, probably a point blank; Cl–19, Cl–20, grooved sandstone.

Scrapers. Two scrapers were found in situ. A snub-nose end scraper, Cl–16 (Fig. 5), was found 140 feet south-southeast of Stake A1, Area I, 11 inches below the surface in the Cody complex sand bed across the basin from Area II. A combination side and end scraper, Cl–17 (Fig. 5), was found in the Cody complex sand in Area II. The snub-nose end scraper is of yellow jasper with dendritic inclusions. It is chipped on one face only, is convexo-concave in cross section and triangular in outline with the scraping edge beveled at an angle of 50° at the widest end. The combination side and end scraper is made from dark gray hornfels. It is bifacially flaked, oval in cross section and rectangular in outline. One end is unchipped; the opposite end is flaked into a low angle, broad bevel. The two sides are chipped and the edges slightly ground, perhaps from use.

Point blank. A large, broken, rectangular piece of gray hornfels, resembling the stem of a giant Cody complex point, is a perplexing artifact (Fig. 5, Cl–18). It could be a rectangular bifacial knife, although the extreme thickness precludes this interpretation. We conjecture that it was the beginning of a point, roughed out by percussion chipping. One side is chipped with deep, wide transverse flakes; the other side by wide, deep collateral flakes by which a slight off-center ridge was formed. The base is thinned by wide, deep flakes. No retouching or smoothing is evident along the edges. It measures 34 mm. long (broken), 31 mm. wide and 14 mm. thick. It is oval in cross section.

Grooved sandstone. Two fragmentary specimens of medium grain, gray sandstone, Cl–19 and Cl–20, were found in situ (Fig. 5). Specimen Cl–19 measures 28 mm. long, 45 mm. wide and 15 mm. thick. It is plano-convex in cross section with a groove in the center measuring 15 mm. wide and 2.5 mm. deep. Specimen Cl–20 is extremely fragmentary. It measures 17 mm. on each side and is 9 mm. thick. It is plano-convex in cross section with a groove in the flat side measuring 7.5 mm. wide

TABLE 2. PROJECTILE POINTS FROM THE SURFACE OF THE CLAYPOOL SITE.

Figure Number	Material	Total Length (mm)	Thinned Base	Stem Length (mm)	Stem Width (mm)	Blade Length (mm)	Blade Width Max. (mm)	Maximum Thickness (mm)	Flaking	Stem Smoothed	Remarks
H-1	Brown flint	39	yes	12	16	35	18	6	Transverse; intermediate	yes	Tip missing; oval cross-section; slight retouch
H-2	Brown flint	47	yes[1]	12[2]	None	35[3]	16.5	7	Transverse; wide, deep	yes	No shoulders; base thinned with long flakes oval cross-section; fine retouch
H-3	Dark gray hornfels	89[4]	yes	13	17.5	70	18	6	Collateral; shallow, narrow; fine retouch	yes	Tip broken; diamond cross-section; fine retouch
H-4	Dark gray hornfels	47	yes	10	16	37	17	4	Collateral	yes	Oval cross-section; fine retouch
H-5	Yellow jasper	56.5[5]?	?	1[5]	18.5	40	20	6	Transverse; irregular	yes	Base and part of stem missing; oval cross-section; fine retouch
H-6	Yellow dendritic jasper	56	yes	14	19	42	20	6.5	Collateral; narrow, shallow	yes	Diamond cross-section; fine retouch edge
H-7	Light yellow chert	38[4]	yes	11	14	27	15.5	5	Collateral; deep, narrow; slightly oblique	yes	Tip missing; modified diamond cross-section
H-8	Mottled red, yellow, white chalcedony	37 ?	yes	13.5	18	?	19	7	Modified transverse; shallow, narrow	yes	Corner, lower half of point missing; oval cross-section; fine retouch
H-9	Yellow jasper	49	yes	12	19	37	22	7	Collateral; medium flakes	yes	Modified diamond cross-section; fine retouch
H-10	Red, dendritic chalcedony	49	yes	15	20	33	21.5	6.5	Collateral; medium flakes	yes	Modified diamond cross-section; fine retouch
H-11	Yellow jasper	57[4]	yes	12	20	41	22.5	7	Collateral; wide, deep flakes	yes	Corner of base and tip missing; diamond cross-section; little retouch
H-12	Brecciated, red mottled yellow quartzite	61	yes	16	18.5	45	20	7	Modified transverse; wide, deep flakes	yes	Modified oval cross-section; little edge retouch
H-13	Light gray chert	48[4]	yes	13	16	32	18	7	Transverse one side, collateral other; wide, deep flakes	yes	Tip missing; oval-triangle cross-section; some retouch on edge
H-14	Light green mottled, white quartzite	46	yes	11	16	33	18	6	Transverse; wide, crude flakes	yes	Section of base missing; modified oval cross-section; little retouch
H-15	Yellow-brown dendritic jasper	71	yes	13	16	58	17	7	Collateral; narrow fine flakes	yes	Diamond cross-section; fine retouch
H-16	Brown flint	47	yes	12	14	35	15	6	Collateral; narrow deep flakes	yes	One shoulder only; diamond cross-section; medium edge retouch
H-17	Gray hornfels	41	yes	15	16.5	26	18	6	Collateral; narrow; medium depth flakes	yes	Diamond cross-section; fine edge retouch
H-18	Yellow jasper	59	yes	12	16	47	17	5	Modified collateral; wide, medium deep flakes	yes	Modified diamond cross-section; fine edge retouch
H-19	Yellow mottled, gray quartzite	60[4]	yes	14	23	46	24	7	Transverse; wide shallow flakes	yes	Flat, lenticular cross-section; fine edge retouch
H-20	Yellow gray chalcedony	62[4]	yes	14	16	48	19	5	Transverse; medium wide, deep flakes	yes	Tip missing; modified diamond cross-section
H-21	Black quartzite	?	yes	15	18	?	19	7	Transverse; wide shallow	yes	Lower half missing; broken edge; modified lenticular cross-section very fine retouch
H-22	Gray-brown chalcedony	70[4]	yes	—	—	—	24	9	Wide, deep	yes[6]	Base edge ground 20x33; flute 20x36; broken tip rolled, long flute is cause
H-23	Yellow, brown jasper	46	yes[7]	--	--	—	20	5	Indeterminate; random; wide, deep.	yes[6]	Flat, lenticular cross-section; base, deep concave
H-24	Brown flint	42	yes	12	13	30	16	5	Indeterminate; wide, deep.	no	Oval-lenticular cross-section; deep concave base; rounded shoulders
H-25	Brown flint	?	?	?	?	?	?	3	Fine; fluted; retouched edges	?	Mid-point fragment

1. Concave.
2. No stem; edge grinding measured.
3. Unground portion.
4. Reconstructed length.
5. Broken.
6. Basal edges ground.
7. 19 mm.

TABLE 3. CODY KNIVES FROM THE CLAYPOOL SITE
(All surface, except Cl-15 which was found in place.)

Figure Number	Material	Thinned Base	Stem Length (cm)	Stem Width (cm)	Blade Length (cm)	Maximum Thickness (cm)	Stem/Blade Angle	Blade Flaking	Stem Ground	Remarks
Cl-15	Dark gray hornfels	yes	19	22	82*	5	15°	Transverse	yes	Tip missing; flat lenticular cross-section
KC-1	Gray quartzite	yes	18	20.5	34*	4	16°	Transverse	yes	Tip missing; oval lenticular cross-section; reshipped blade
MC-2	Green mottled, gray quartz	yes	15	19	41*	5.5	16°	Transverse	yes	Tip missing; oval lenticular cross-section
MC-3	Brown flint	yes	12	15	37	5	24°	Modified transverse	yes	Lenticular; trend toward diamond cross-section
MC-4	Mottled, brecciated yellow jasper	yes	25	26	56*	5	30°	Indeterminate	yes	Tip missing; flat lenticular cross-section
MC-5	Red brown jasper	yes	17	19	40	6	25°	Collateral Transverse	yes	One side collaterally flaked other side transversely flaked
MC-6	Mottled, brecciated yellow jasper	yes	17	24	?	5.5	25°	Indeterminate	yes	Most of blade missing; flat lenticular cross-section
MC-7	Brown flint	yes	8	21	107	4	18°	Indeterminate	yes	Flat lenticular cross-section; lower third of blade missing
MC-8	Gray mottled, light yellow jasper	yes	13	20	?	5.5	?	Transverse	yes	Flat lenticular cross-section; most of blade missing
MC-9	White mottled, brown flint	yes	18	24	43	5	38°	Indeterminate	yes	Oval lenticular in cross-section
MC-10	Light gray chalcedony	yes	18	20	?	?	?	?	yes	Stem only

* Reconstructed length.

and 1.25 mm. deep. The purpose of these artifacts is problematical. They do confirm four larger specimens found by Mountain on the surface of the side as probably belonging to the Cody complex.

THE MOUNTAIN COLLECTION

Bert Mountain's collection of artifacts from the surface of the Claypool site greatly exceeds in number those excavated. Perhaps of even greater importance was the careful attention Mountain gave to cataloguing the collection, for his material constitutes an estimated 90% of the specimens studied from the site. On the other hand, Mountain's collection would be of little use except for typological studies if we had not been able to isolate the specific bed in which occupation was present.

Projectile points. Detailed measurements of Mountain's Cody complex points presented in detail are for only those points complete enough for measurement analysis (Table 2, Fig. 6). A total of 110 point specimens was collected from the surface. The total includes fragments, almost whole, and whole points. The following tabulation illustrates the condition of the material:

Cody complex points	
Point tips	23
Mid-blades	20
Stems	41
Measurably whole	21
Folsom point fragment	1
Clovis point	1
Undetermined points	3
Total	110

The typology of the measurably whole Cody complex points is as follows: 15 Eden points, three Scottsbluff points (M-19, possibly M-12 and M-18). One is undetermined (M-2). Eleven of the Cody complex points are collaterally flaked; nine are transversely flaked and one is a combination of the two types of flaking. Points M-24 and M-23 (Fig. 6) are not regarded as Cody complex points.

Despite the variations in regard to size, many being smaller than average for the known Cody complex points, certain characteristics are apparent. Almost all have parallel flaking, parallel sided stems, ground stem edges, and thinned bases. The blades on most taper evenly from the shoulders to the tip; a few have parallel sides for a short distance below the shoulders. The Eden point range in total length is from 38 mm. to 71 mm. Stem lengths range from 10 mm. to 15 mm.; widths from 14 mm. to 20 mm.; blade lengths from 26 mm. to 70 mm. Maximum thickness of points ranges from 4 mm. to 7 mm. These measurement ranges show the rather extreme variation in point size at the Claypool site and agree well with the excavated material. The Scottsbluff points are not summarized in regard to size range variation because of the small number of specimens.

Cody knives. Ten were found by Mountain on the Claypool site (Fig. 7, Table 3). The measurable specimens range in length from 44 mm. to 115 mm. Maximum width of the blades ranges from 18 mm. to 32 mm.; maximum thickness from 3 mm. to 6 mm. The stem/blade angle range is from 18° to 46°. The flaking is about evenly divided between indeterminate and transverse.

Bifacial knives. Thirteen were found by Mountain (Fig. 7, BK-1 — BK-4). Only three are whole; ten are fragmentary and the conjectural shapes below can only be alluded to by judicious reconstruction. The predominant shape is triangular; leaf-shaped blades are present in a few instances and one is an oval ellipse. All are lentic-

ular in cross section. The very wide and sometimes deep flake scars indicate percussion chipping; most have a minimum of retouch. The whole, triangular specimens range from 32 mm. to 79 mm. in length; 27 mm. to 29 mm. in width; and 7 mm. to 10 mm. in thickness. These do not represent the largest knives, inasmuch as one specimen with the base missing measures 92 mm. in length by 39 mm. in width. The oval ellipse specimen measures 46 mm. in length, 23 mm. in width and 11 mm. in thickness. The material used in the manufacture of these knives is quite diverse, consisting of yellow and red jasper, light gray chalcedony, black, yellow and green quartzite, and white chert.

Side scrapers. Sixteen side scrapers were found by Mountain (Fig. 7, SS–1 — SS–3). These are large flakes with a distinct chipped and retouched scraping bevel on one or more sides. Nine have one scraping edge; five have two scraping edges and two have three scraping edges. The bevels are about equally divided between high and low angles. The cross sections are about equally divided between plano-convex and convexo-convex. Several are plano-plano. In outline they are almost equally divided into triangular and rectangular shapes. One is classified as oval. These scrapers range in length from 33 mm. to 64 mm.; in width from 12 mm. to 40 mm., with the greater number averaging about 30 mm. Range in

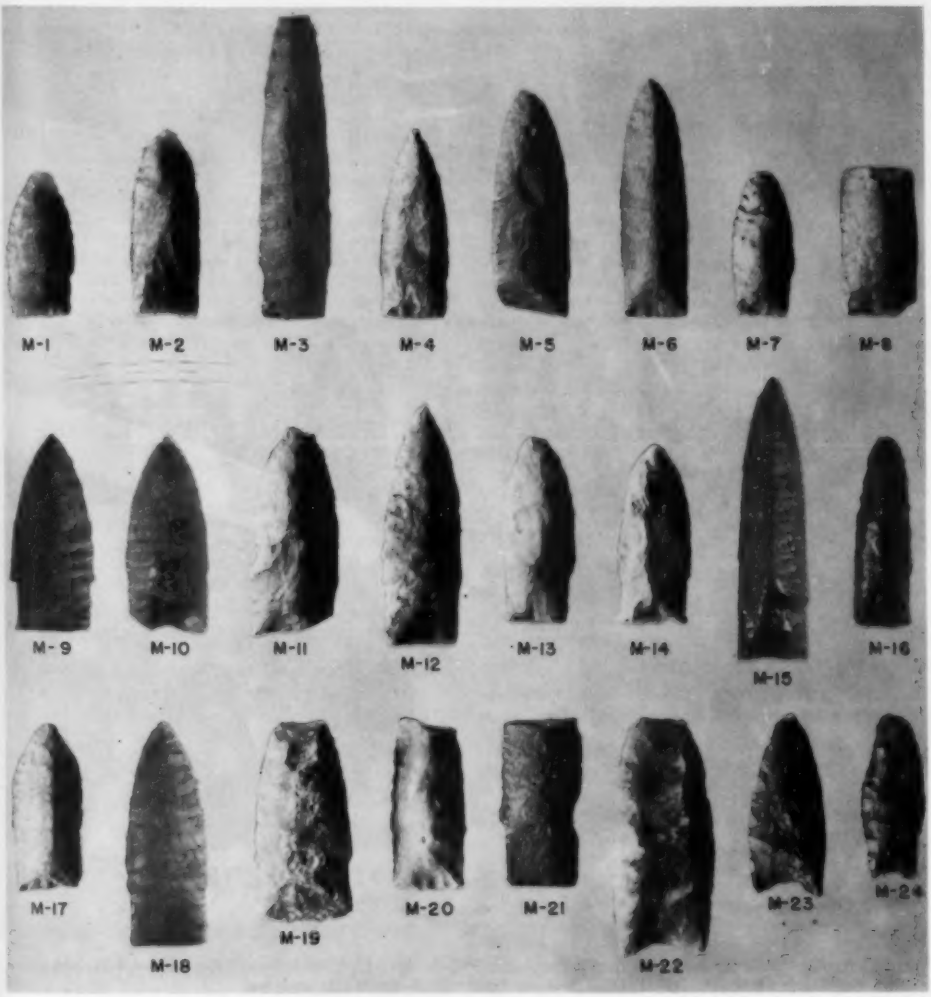

FIG. 6. Identifiable projectile points in the Mountain collection from the surface of the Claypool site.

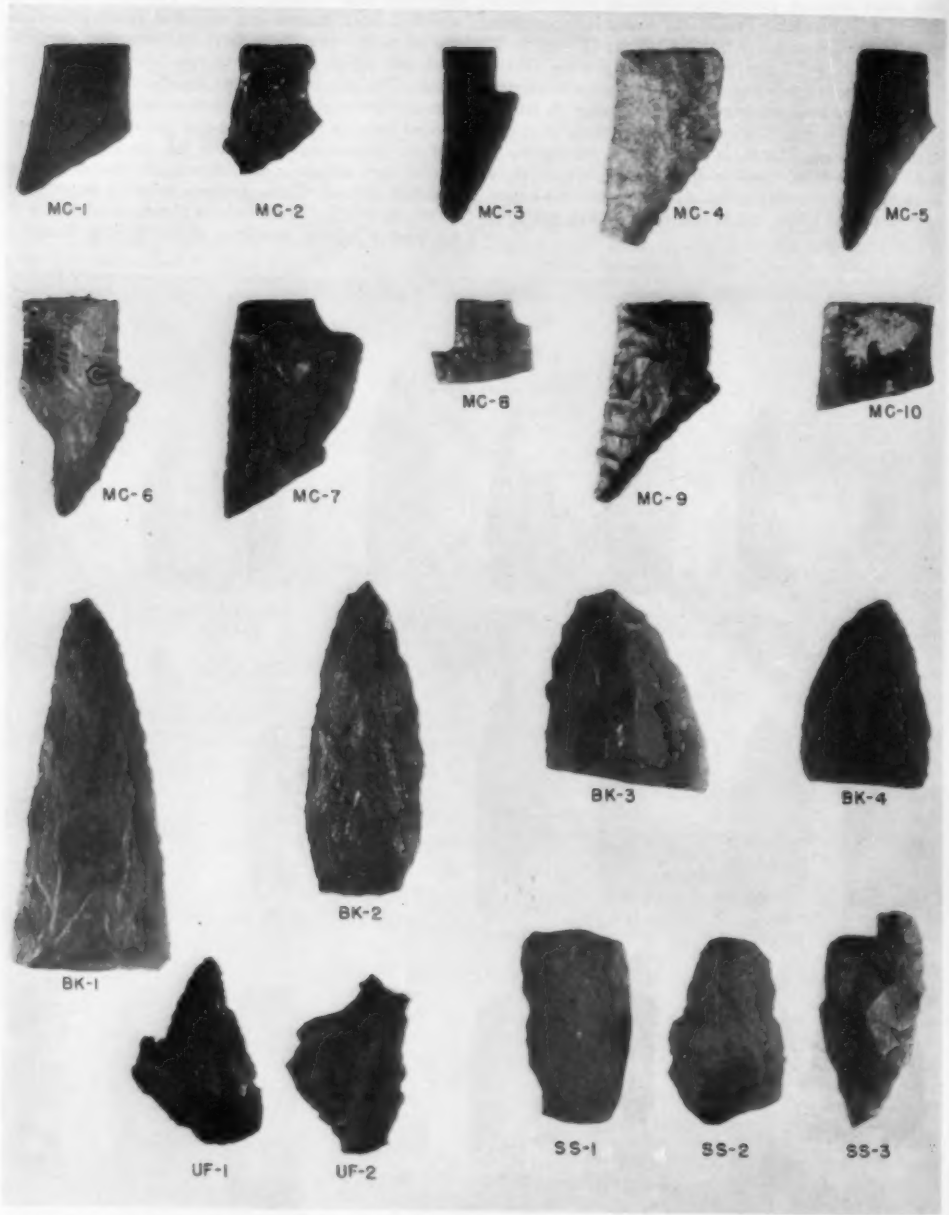

Fig. 7. Artifacts from the surface of the Claypool site. MC–1—MC–10, Cody knives; BK–1—BK–4, bifacial knives; UF–1, UF–2, utilized flakes; SS–1—SS–3, side scrapers.

TABLE 4. DRILLS FROM THE SURFACE OF THE CLAYPOOL SITE.

Figure Number	Material	Length (mm)	Maximum Width (mm)	Thickness (mm)	Base	Cross Section	Remarks
MD-1	Mottled red, white chalcedony	51[1]	14	4	Expanding; straight	Diamond	Tip missing
MD-2	Light gray chalcedony	73[1]	20	8	Expanding; straight	Diamond	Tip missing
MD-3	Light gray chalcedony	65[1]	16	6	Expanding; concave	Diamond	Tip missing
MD-4	Brown flint	?	?	4	?	Diamond	Lower blade only

1. Reconstructed length.

thickness is from 3 mm. to 14 mm., with most between 5 mm. and 10 mm. The material is red and yellow jasper, yellow quartzite, gray hornfels, mottled chalcedony, and gray chalcedony.

Snub-nose end scrapers. Thirty-four of these scrapers were found on the site by Mountain (Fig. 8, SN–1 — SN–7). These tools cannot be distinguished as any different from similar specimens found in the Lindenmeier Folsom complex (Roberts 1935: 23–33) and historic sites on the High Plains. They do not vary extensively in form and size. One characteristic common to all is the single, steeply beveled, scraping edge. Most are convexo-concave in cross section in a line at right angles to the scraping edge; several are plano-convex in cross section. Twenty-five are triangular in outline; nine are somewhat rectangular. The side opposite the scraping edge on the rectangular specimens tends to be foreshortened into a rounded or straight edge. The snub-nose scrapers range in length from 20 mm. to 43 mm.; the greatest number range between 25 mm. and 30 mm. The range in width of the scraping end is from 16 mm. to 39 mm.; the greatest number range in width between 23 mm. and 30 mm. They range in thickness from 4 mm. to 17 mm.; the greatest number range between 6 mm. and 9 mm. The bevel angle of the scraping edge ranges from 45° to 85°; the scrapers are evenly distributed within this range. The material most frequently used is yellow jasper. Other material includes brown flint, light gray chalcedony, mottled chalcedony, and red jasper.

Drills. The four drills found by Mountain display flaking almost as fine as that found on the projectile points (Fig. 8, MD–1 — MD–4, Table 4). Three consist of the base and blade, the tip missing on each. The fourth is the lower blade only, with the tip missing. The drills are triangular shaped. The bases of MD–2 and MD–3 are slightly flared. The blades on all are diamond shaped in cross section. One displays distinctive collateral flaking; the others, modified collateral flaking.

Gravers. Ten flakes with graver points were found by Mountain (Fig. 8, G–1 — G–4). These are irregular flakes with delicately rechipped, narrow points. They were select flakes which lent themselves to convenient chipping of a graver point. One specimen is a modified end scraper. The gravers range in length from 12 mm. to 32 mm., and in thicknes from 3 mm. to 7 mm. The material used is yellow and gray jasper, and brown flint.

Utilized flakes. Several thousand small flakes were collected on the Claypool site. Eighteen larger flakes show usage or have retouched flakes removed from one or more edges. These are regarded as tools (Fig. 7, UF–1, UF–2). Three flakes have been identified as flake knives and 15 flakes as scrapers. The flakes range from 16 mm. to 48 mm. in length; 13 mm. to 33 mm. in width; and 3 mm. to 9 mm. in thickness. The material most commonly used is yellow jasper. Other material is red jasper, gray hornfels, and light gray chalcedony.

Grooved sandstone. Four rectangular pieces of medium grain sandstone, ranging from tan to buff in color and having one or more grooves, were found by Mountain (Fig. 8, MGS–1 — MGS–4, Table 5). It is conjectured that these could have been used for grinding the stem edges on Cody knives and projectile points. It is possible that specimen MGS–4 was used to grind wooden projectile shafts.

THE ANDERSON COLLECTION

The Perry and Harold Anderson collection consists almost entirely of projectile point fragments. The Andersons had a penchant for picking up tantalizing fragments on the Claypool site. The collection exemplifies the care they expended in searching the surface. Fifty-two fragments and one whole point were found.

TABLE 5. GROOVED SANDSTONE FROM THE SURFACE OF THE CLAYPOOL SITE.

Figure Number	Length (mm)	Width (mm)	Thickness (mm)	Number of Grooves	Cross-section	Groove Width (mm)	Groove Depth (mm)	Remarks	Material
MGS-1	65	30	15	6	Plano-convex	6-6-10 6-7-7	1-1-1.5 1-1-1	One end rubbed	Sandstone
MGS-2	48	28	17	1	Plano-convex	13	2	Convex side rubbed	Sandstone
MGS-3	(broken) 69	45	22	1	Plano-convex	8	2	All sides rubbed	Sandstone
MGS-4	40	32	19	1	Plano-convex	14	4	Possible projectile point shaft	Sandstone

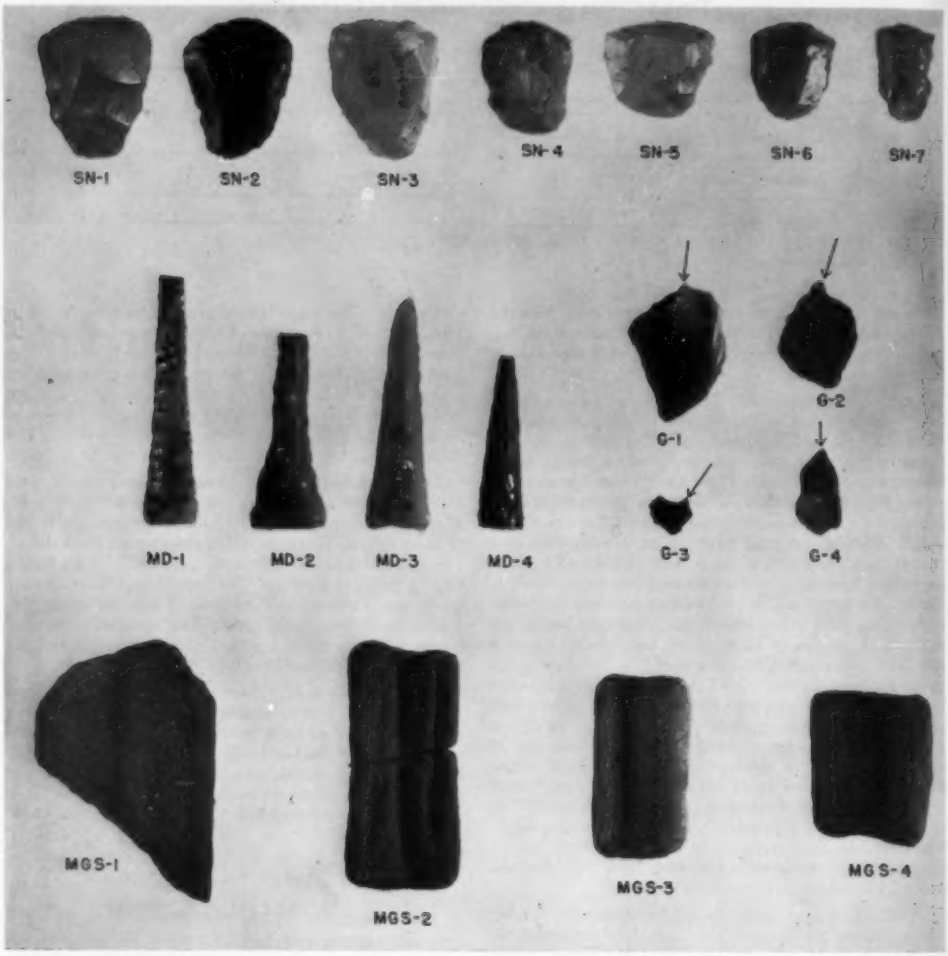

Fig. 8. Artifacts from the surface of the Claypool site. SN–1—SN–7, snub-nose end scrapers; MD–1—MD–4, drills; G–1—G–4, gravers; MGS–1—MGS–4, grooved sandstone.

Thirty-five are stem/base fragments; the rest are midpoint sections and tips. We conjecture that the material was for the most part from Eden points, and that the many stem/base fragments are not the result of breakage in flaking, but represent points broken on hunts. The hunters possibly recovered the projectile shafts with the attached basal sections of the points remaining in them. Upon reaching camp they replaced the broken bases with new points. Because of the fragmentary nature of the Anderson collection it has been neither pictured nor tabulated in this report.

Summary

The Claypool site provides geological and stratigraphic evidence for the location of artifacts belonging to the Cody complex in northeastern Colorado. The material found in situ includes Eden points, a Scottsbluff point, a Cody knife, several scrapers, pieces of grooved sandstone, scraps of charred and uncharred bone (probably bison), and numerous small flakes of stone struck off in the manufacture of these tools. According to Malde (1960), the artifacts occur in an eolian deposit which prob-

ably accumulated under cool dry conditions preceding the Thermal Maximum. He estimates on the basis of the postglacial climatic succession that the date for the Cody complex occupation is 10,000 to 7000 years ago.

The Mountain collection of Cody complex artifacts from the surface of the Claypool site is partially validated by the fact that portions of several projectile points found by him on the surface fitted some of those later found in situ. Further, on the basis of similarity of material, design, and locale of collecting, we believe the bulk of Mountain's collection can be assigned to the Cody complex and is contemporaneous with the material found in situ. Additional artifacts not found in situ but found by Mountain and attributed to the Cody complex are bifacial knives, gravers, drills, and flakes utilized as rough knives and scrapers.

Perhaps the most interesting, but somewhat enigmatic problem is the diversity in length and form of some of the points. We believe this diversity is normal in an over-all consideration of the Cody complex. Too frequently the types are set up with carefully selected and distinct specimens, which is proper; on the other hand, these types become stereotypes to the degree that any "aberrant" specimens, even though recurring occasionally, are not recognized unless found in direct association with the stereotypes. Thus, we leave any problems of new types to the future when new excavated assemblages will better reconcile the full range of the Cody complex points.

Acknowledgments. The Claypool site was excavated by the Daniel Houtz–University of Colorado Museum Expedition. The financial contribution of Houtz to the project is gratefully acknowledged. Hugo Rodeck, Director of the University of Colorado Museum, and Marie Wormington, Curator of Anthropology of the Denver Museum of Natural History, made the completion of this report possible. Appreciation is due the excavators: Bradley White and Troy Anderson of Boulder, Jerry Blair and Tom Franck of Denver, and Al Parrish of Akron, Colorado. Mrs. Mountain and Jimmy Mountain also had an active part in the project. Charles Hunt, U. S. Geological Survey, Denver, identified geological horizons and beds during a brief inspection of the site. Harold Malde, U. S. Geological Survey, Denver, carried out the geological investigation of the site. Thanks are extended to Forrest W. Claypool, Yuma, Colorado, for permission to excavate on his land, to Joe Frenzle, school board member in Akron, Colorado, for permission to use an abandoned school house near the site for field quarters, and to the farmers and the ranchers of the region who aided us in many ways.

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March, 1960

GEOLOGICAL AGE OF THE CLAYPOOL SITE, NORTHEASTERN COLORADO *

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ABSTRACT

Artifacts related to the Cody complex occur in medium-grained sand that is spread as a blanket eolian deposit a few feet thick in the Claypool site area, Washington County, Colorado. The artifact-bearing sand lacks noticeable dunal topography and lies unconformably on marl of Yarmouth age and on waterlaid coarse sand and fine gravel of Kansan age that underlie the marl. The deposits underlying the artifact-bearing sand are much too old to date the artifacts precisely, but the physical characteristics of the artifact-bearing sand suggest that it was deposited under conditions cool and dry, rather than warm and dry, possibly during retreat of Valders ice that began about 10,000 years ago. A moderately mature Brown Soil about 5 feet thick developed on the sand, possibly about 7000 to 5000 years ago during a moist phase of the Thermal Maximum. Thus, the artifacts are possibly 10,000 to 7000 years old. Deposits which overlie the artifact-bearing sand reflect several episodes of erosion and sedimentation that are inferred to represent climatic changes.

NORTHEASTERN COLORADO has long been a collecting ground for artifacts of Early Man. Among the most extensive of the private collections was that of Perry and Harold Anderson of Yuma, Colorado, gathered primarily from Yuma and Washington counties. The Anderson collection was examined in 1928 by A. E. Jenks and later by E. B. Renaud (1931, 1932) who applied the name Yuma to the distinctive, slender, parallel-flaked projectile points which dominate the types represented. This name has fallen into disfavor because of the variety of points to which it was applied, and because the points are connected neither with the Yuman linguistic family nor with the Yuma tribe of the lower Colorado River area (Wormington 1957: 103). The northeastern Colorado artifacts include projectile points which resemble those at the Finley site, near Eden, Wyoming (Howard 1943), and others which resemble those found at the Scottsbluff bison quarry, west of Scottsbluff, Nebraska (Barbour and Schultz 1932). Both the Eden and Scottsbluff projectile point types are included in the Cody complex, a cultural association designated by G. L. Jepsen (1951, 1953).

Herbert W. Dick spent two months during 1953 in northeastern Colorado excavating at a deflation basin he named the Claypool site, after the property owner. The artifacts he found in place are the first to be recovered during systematic excavation; they include 11 projectile points of Eden type, one of Scottsbluff type, and a Cody knife. Cody knives are stone tools known elsewhere only at the Horner site near Cody, Wyoming (Wormington 1957: 128). Results of the archaeological excavation are presented in the accompanying paper by Dick and Mountain (1960). The Claypool site is in a deflation basin in Washington County, Colorado (Fig. 1), 19 miles south and 4 miles east of Otis (SE¼ sec. 18, T. 2 S., R. 49 W.). The site is within an area of sand hills which extends eastward into Yuma County and includes most of the ground where artifacts have been collected. About 3 miles west of the site the sand hills disappear, giving way to a gently undulating plain underlain by loess and eolian sand.

Only Quaternary deposits are exposed at the Claypool site, but in the Wray area, Colorado, 35 miles east of the site (Fig. 1), the Pierre shale (Late Cretaceous) and the Ogallala formation (Pliocene) crop out along the valley walls of the larger streams (Hill and Tompkin 1953, Pl. 1). Algal limestone high in the Ogallala formation crops out west of the Claypool site on ridges crossed by State route 61. Geological mapping in the Wray area, and reconnaissance in nearby Nebraska (Condra, Reed, and Gordon 1950; Schultz, Lueninghoener, and Frankforter 1951) and Kansas (Frye and Leonard 1952), show that the Quaternary deposits of the region are characterized by widespread loess and eolian sand on the uplands, and by more or less deep alluvial fills in the valleys. These two kinds of materials commonly intertongue, and both contain soil profiles which are correlated with interglacial weathering (Schultz and Stout 1945; Frye 1951). The soil profiles are regarded as useful "marker horizons" for tracing deposits from one place to another, and for correlating them over longer distances.

Deposits at the Claypool site are here divided into Pleistocene and Recent. Those older

* Publication authorized by the Director, U.S. Geological Survey.

FIG. 1. Location map of the Claypool site.

than the sand hills include the artifact-bearing bed and are considered Pleistocene; those of the sand hills are classed as Recent.

PLEISTOCENE DEPOSITS

The Pleistocene deposits include two units: (1) basal sand with a bed of fossiliferous marl at the top, and (2) artifact-bearing sand on which is developed a mature soil profile. An unconformity separates the marl from the artifact-bearing sand.

BASAL SAND AND MARL

Outcrop and distribution. The lowest parts of the deflation basin at the Claypool site expose about 3 feet of coarse sand beneath a more or less flat-lying marl bed 1 or 2 feet thick. The marl is also exposed in places along the bottom of an undrained valley a quarter of a mile east of the site (Fig. 2). Lithologically similar marl and sand underlie deflation basins farther north and east in Yuma County.

Lithology. The basal sand is a light yellowish-gray mixture of sorted medium and coarse sand (0.25–1.00 mm.) composed of subrounded grains of quartz with some pink and white feldspar and a few granite fragments as large as half an inch. Where freshly exposed the sand appears massive, but where etched by wind low-angle cross-bedding can be seen. The bedding characteristics and size-sorting suggest that the sand was water-laid. The marl bed, although dominantly calcareous clay and silt, contains sand similar to the basal sand on which it lies; the downward change from marl to sand appears gradational. In places on the marl are lenses of very dark brown, loose, carbonaceous sand a few feet across and a few inches thick. Presumably, these carbonaceous lenses are comprised of residues of plants which grew in boggy ground. Fresh water mollusks are abundant in the marl, and the remains of a disarticulate mammoth were dug from it by Dick. Mammoth remains are also reported from marl beds in Yuma County (Gebhard 1949).

Age and correlation. Paleontology and physical geological relations suggest that the basal sand and marl correlate, respectively, with the Grand Island formation (Kansan) and the Sappa formation (early Yarmouth) of Nebraska and Kansas. A collection of mollusks made by G. R. Scott and Richard Van Horn, U.S. Geological Survey, from the marl at the Claypool site was examined by Cornelia Cameron, U.S. Geological Survey, who identified the following:

Fresh water gastropods:
- * *Gyraulus labiatus* Leonard
- *Gyraulus parvus* (Say)
- *Helisoma trivolvis* (Say)
- *Physa anatina* Lea
- * *Physa eliptica* Lea
- * *Stagnicola palustris* (Say)
- * *Lymnaea bulimoides* Lea

Land gastropods:
- *Vallonia pulchella* (Müller)
- *Vertigo ovata* Say
- *Hawaiia miniscula* (Binney)
- *Succinea avara* Say
- *Retinella electrina* (Gould)

Pelecypods:
- *Pisidium* sp.

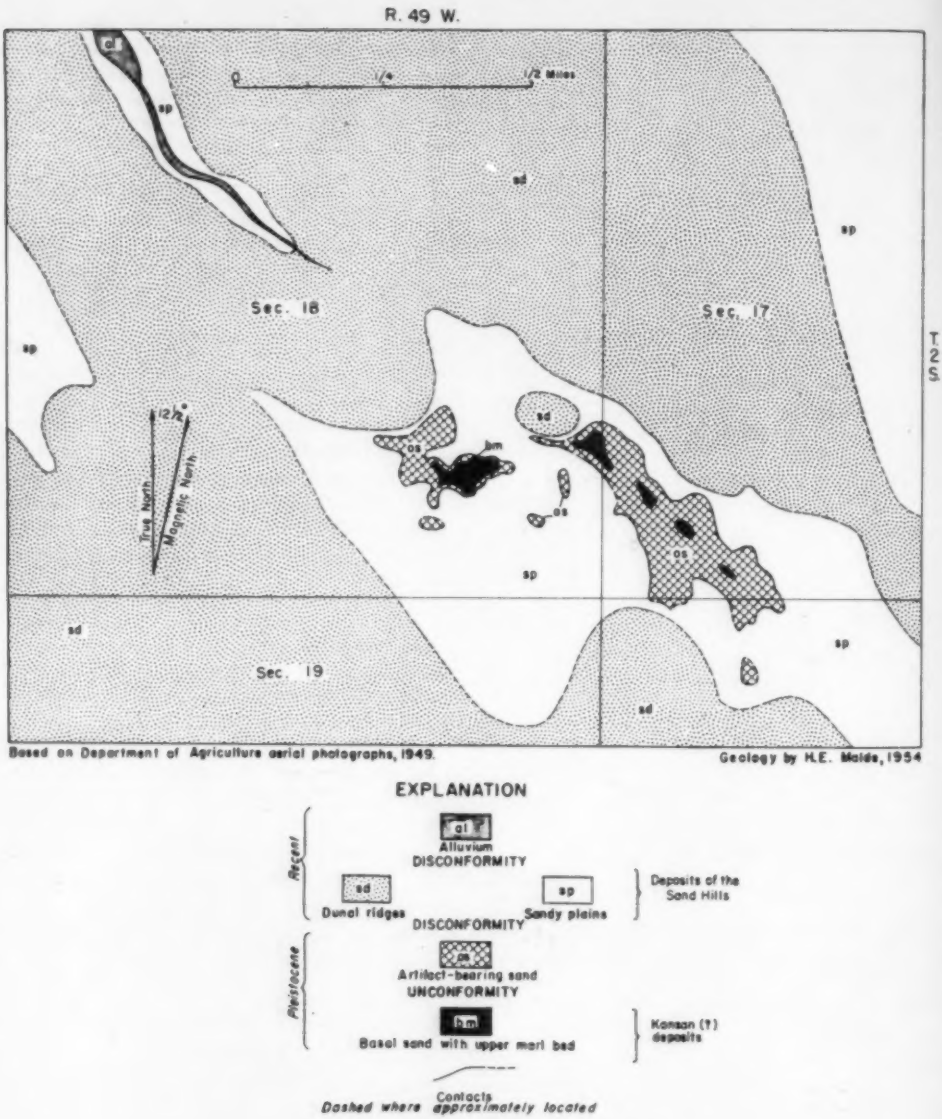

Fig. 2. Geological map of the Claypool site.

The starred species have not been reported by Leonard (1952: 8) in deposits younger than the Sappa formation. According to Cornelia Cameron (written communication), "the fauna is typical of species described in the Sappa . . . in Kansas . . . *Gyraulus labiatus* became extinct at the close of the Sappa. The other species are living elsewhere in the United States."

The faunal similarity of the marl with the Sappa formation corresponds with observations made in the Wray area. On top of some deposits in the Wray area that are correlated with the Grand Island formation is marl containing mollusks, ostracods, and diatoms which suggest correlation with the lithologically similar Sappa formation (Hill and Tompkin 1953:

23–5). The basal sand at the Claypool site, in its lithology, topographic occurrence, and association with an overlying marl bed, resembles the deposits near Wray that are correlated with the Grand Island formation.

ARTIFACT-BEARING SAND

Outcrop and distribution. The deposit containing artifacts of the Cody complex consists of a layer of medium-grained sand from 3 to 8 feet thick that lies on an irregular surface carved on the marl bed and the basal sand. The artifact-bearing sand is mostly concealed by deposits of the sand hills but it crops out in several places surrounding the site (Fig. 2). Where the sand hills disappear about 3 miles west of the site, the artifact-bearing sand forms an undulatory plain of low relief lacking well-developed external drainage and containing occasional flat-floored undrained depressions about 5 feet deep. Probably these depressions represent old, sod-covered deflation basins. The sand is also intermittently exposed north and east in the sand hills area of Washington and Yuma counties. The artifact-bearing sand appears to be a blanket deposit of eolian origin, without well-developed dunal forms, that covers a surface of low relief.

Lithology. The artifact-bearing sand consists dominantly of very well-sorted, subrounded, polished, medium grains of quartz sand (0.25–0.50 mm.). Scattered through the sand are very well-rounded and frosted coarse grains which include feldspar. No bedding can be seen, either in freshly dug pits or in air-dried bank exposures. Soil development has colored the upper part of the sand dark brown, but the relatively unoxidized lower part is pale brown or very pale brown. The soil profile in the artifact-bearing sand is described in the section that follows in two parts, Units 3 and 4, which are regarded as soil horizons (Table 1).

The soil profile on the artifact-bearing sand is regarded as a moderately mature Brown Soil that developed prior to burial by younger deposits. Soils of this type are characterized by a brown B horizon (Unit 4), columnar-jointed and enriched in clay and oxides, underlain by a subsoil horizon (Unit 3) enriched in calcium carbonate. The perfection of columnar structure varies directly with the amount of clay. The soil profile extends continuously with the artifact-bearing sand many miles west, north, and east. Where the sand is thick, the profile is developed above unweathered sand; where the sand is thin, the lower soil horizon extends downward into older deposits. Carbonate in the soil appears to have been precipitated while clay and oxidation products that formed at the surface were accumulating in the B horizon.

The distribution of soil types within the Great Plains suggests the climatic environment under which the soil on the artifact-bearing sand developed. Soils of the Great Plains grade northeastward into less calcareous soils that are grayer and darker; southeastward, they grade into less calcareous soils that are redder and brighter. Medium-colored, calcareous soil like that at the Claypool site, compared to these other soils, appears to reflect intermediate temperature and lesser precipitation. But the climate during which the soil formed no doubt was wetter than the climate before or after, for the following reasons. A buried soil developed on an eolian deposit demonstrates a climatic change: a relatively dry climate would favor eolian activity and inhibit soil formation; subsequently, a relatively moist climate would impede eolian activity by favoring plant growth and the formation of soil; the return of relatively dry climate would favor resumption of eolian activity.

Age and correlation. The age of the artifact-bearing sand is at best a guess, within the rather long interval from the Kansan age to Recent, but its approximate stratigraphic position can be inferred by comparison with deposits nearby. These comparisons suggest that the artifact-bearing sand is probably equivalent to the Bignell loess of late Wisconsin age in Kansas and Nebraska. In the Wray area, Hill and Tompkin (1953: 28–30) identified calcareous silt and clay, locally very sandy at the top, of late Pleistocene and Recent age. They correlated most of the silt and clay with Peorian loess, but considered some deposits overlying a buried soil as possibly equivalent to the Bignell loess (Hill and Tompkin 1953: 27–8).

In Nebraska, the Bignell loess rests on a well-zoned soil profile named the Brady soil (Schultz and Stout 1948: 570), developed on Peorian loess. In the top of the Bignell loess is a weathering profile called soil Y which is in turn buried by younger deposits (Schultz and Stout 1945: 239, 241, 243). At Bignell Hill, 1.7 miles south of Bignell, Nebraska, this weathering profile (soil Y) is 4.3 feet thick (Thorp, Johnson, and Reed 1951: 14). Compared to

TABLE 1.

GENERALIZED STRATIGRAPHY AT THE CLAYPOOL ARCHAEOLOGICAL SITE, WASHINGTON COUNTY, COLORADO (SE¼ SEC. 18, T. 2 S., R. 49 W.)

Description of Unit (Terminology used to describe soil characteristics is adapted from Soil Survey Manual, U.S. Dept. of Agriculture Handbook No. 18, 1951)	*Thickness (feet)*
Modern deposit (not mapped):	
Unit 7. Sand, fine to coarse, loose, pale brown. This is an active layer of wind-driven sand	0–3
Boundary clear (less than 2 inches wide), irregular; drawn at base of bunches of grass.	
UNCONFORMITY	
Deposits of the sand hills:	
Unit 6. Sand, medium with some coarse, loose to faintly friable, brown (10 YR 5/3). Grass roots common. Deposit is banded more or less horizontally; bands are dark brown, wavy, and half an inch to one inch thick; the upper boundaries are sharp	3
Boundary diffuse (more than 5 inches wide).	
Unit 5. Sand, medium with some coarse (as in Unit 6), loose to faintly friable becoming faintly more compact in lower part, otherwise massive, brown (10 YR 5/3)	2
Boundary sharp (less than ½ inch wide), irregular.	
DISCONFORMITY	
Artifact-bearing sand:	
Unit 4. Sand, dominantly medium-grained, firm, dark brown (7.5 YR 4/4). Sand grains coated with clay and oxides, especially in upper half. Massive when moist and freshly exposed; moderate columnar structure revealed when air-dried. Vertical veinlets of calcium carbonate spaced one inch or more apart visible in lower part when dry. Artifacts of the Cody complex occur in lower half in an area measuring 45 by 50 feet on the north side of the deflation basin. (This layer is interpreted as the B horizon of a Brown Soil. Where the artifact-bearing sand is thin, this soil horizon rests on Unit 2.)	3
Boundary diffuse (more than 5 inches wide).	
Unit 3. Sand, medium-grained (as in Unit 4), friable, calcareous, brown to pale brown (10 YR 5/3–6/3) becoming very pale brown (10 YR 7/3) at base; faintly mottled. Massive when moist and freshly exposed; breaks out in vertically-jointed blocks 3 to 6 inches wide when air-dried; faces of blocks are whitened with calcium carbonate after air-drying, and carbonate in the blocks forms a weak cement. No artifacts found. (This layer is interpreted as the calcareous subsoil of a Brown Soil. Where the artifact-bearing sand is thin, the carbonate of this soil horizon is incorporated in Unit 2.)	0–5
Boundary very sharp, wavy.	
UNCONFORMITY	
Marl bed:	
Unit 2. Sand with some fine pebble gravel, very firmly cemented with calcium carbonate and interstitial clay and silt, light yellowish-gray (2.5 YR 7/2) to light olive-gray (5 Y 7/2). Crudely stratified in layers of contrasting textures 2–4 mm. thick. Some layers rich in fresh-water mollusks; bones of mammoth excavated from top few inches. Lenses of very dark brown, carbonaceous, loose sand a few feet across and a few inches thick are preserved locally at the top; limy layers that underlie these lenses are pale yellow and pulverulent for a few inches downward	2
Boundary gradual (2½–5 inches. wide).	
Basal sand:	
Unit 1. Sand, medium and coarse with some fine pebble gravel, moderately calcareous, light yellowish-gray (2.5 Y 7/2). Crudely stratified in layers 2–4 mm. thick; low angle cross-bedding	3+
Base not exposed.	

the soil on Peorian loess, the soil on the Bignell loess is about half as thick and less distinctly zoned. These contrasts in thickness and distinctness of zonation resemble the contrasts I have observed between soil on the artifact-bearing sand at the Claypool site and the soil developed on the Peoria loess of the region. Schultz, Lueninghoener, and Frankforter (1951: 8) regard soil Y as of post-Mankato age — that is, post-Valders in age according to more recent

classification. A sample of this soil from 120–134 inches below the top of a terrace fill along Louisa Creek in Webster County, Nebraska, about 230 miles east of the Claypool site, gave a radiocarbon date of 4150±350 years (Libby 1952: 677, C–649).

In Kansas, soil on the Bignell loess is also thinner and less distinctly zoned compared to soil on Peorian loess, as shown in a photograph by Frye and Leonard (1952, Pl. 12A). The artifact-bearing sand at the Claypool site, like the Bignell loess, is weathered and overlain by younger eolian deposits. Not many miles from the site, deposits physically similar to the artifact-bearing sand overlie a soil developed in probable Peorian loess. These stratigraphic relations suggest to me that the artifact-bearing sand most likely correlates with the Bignell loess.

Antiquity of the artifacts. The interval of deposition of the Bignell loess (assuming that the artifact-bearing sand is actually this age) was comparatively long, relative to the Early Man occupation of North America, and, thus, it is helpful to search for further clues that might date the artifacts more precisely. These clues are subjective, rather than tangible, but imply that Early Man could have occupied the site from 10,000 to 7000 years ago. These clues are mostly inferences as to past climate.

The buried soils in Pleistocene deposits in Kansas and Nebraska are considered to have developed during interglacial times (Frye 1951; Schultz, Lueninghoener, and Frankforter 1951: 29) when the climate was more moist than that which favored deposition of loess, and presumably was warmer. Probably, the soil on the artifact-bearing sand developed during such a warm-moist interval. If the sand is correlative with Bignell loess, the soil could have formed only during postglacial time. In the European succession of postglacial climates a warm-moist interval has long been recognized by study of the stratigraphic relations of peats and associated sediments laid down in lakes, streams, and in the sea. To some extent a similar postglacial climatic succession has been recognized in temperate North America and in other parts of the world. The status of knowledge on this succession has been recently summarized by Deevey (1953: 274–9). Deevey's chronological table of postglacial climatic succession contains a warm-moist interval that dates, in the European chronology, 7000 to 5000 years before the present (B.P.) — for an analysis of the European chronology see Flint and Deevey (1951: 276–7). This was preceded by a warm-dry interval 1000 years long, beginning about 8000 B.P., and was succeeded by another warm-dry interval 2400 years long, ending about 2500 B.P. The entire warm period consisting of dry, moist, and dry episodes is called the Thermal Maximum — also referred to as the Climatic Optimum or the Altithermal Age (Antevs 1948). Thus, if the soil on the artifact-bearing sand can be correlated with the warm-moist interval 7000 to 5000 years ago, the occupation of the site is more than 7000 years old.

Clues as to the maximum age of the artifact-bearing sand are less easy to find. As an eolian deposit, the artifact-bearing sand surely accumulated under dry conditions, but these could have been either warm or cool. Because dunes are forming today in this region under warm-dry conditions, perhaps the artifact-bearing sand, as a blanket deposit lacking dunal topography, reflects opposite conditions — cool and dry. These conditions presumably would prevail during retreat of Valders ice, and would have begun about 10,000 years ago.

Recent Deposits

Recent deposits at the Claypool site include those that form the sand hills which disconformably overlie the artifact-bearing sand, and small bodies of alluvium which lie in areas of closed drainage between ridges in the sand hills. Small, low hills composed of sand, blown from deflation basins scattered through the area of sand hills, probably are less than 100 years old.

Deposits of the Sand Hills

Outcrop and distribution. The deposits of the sand hills include two intertonguing units, similar lithologically, but differing in depositional form and outcrop. One of these units comprises the complex dunal ridges (sand hills); the other unit forms sandy plains between the ridges. The dunal ridges, covering about two-thirds of the region surrounding the Claypool site, are composed of overlapping parabolic dunes, open to the northwest, the prevailing source of wind. The ridges are commonly more than half a mile wide, several miles long, and rise more than 50 feet high. They taper at the southeast to a rounded terminus, and their northwesterly extremities are

broad, low, and ill defined. Although lacking a cover of sod, the ridges are more or less stabilized and support grass, sage, and yucca. Between the ridges are sandy plains of low relief composed of sand deposits less than 15 feet thick. The sandy plains support vegetation similar to that on the ridges, but the vegetation is more closely packed and grassy. Lower lying areas within the sandy plains supporting relatively lush vegetation reflect a shallow water table.

Lithology. The deposits of the sand hills consist of well-sorted medium-grained quartz sand (0.25–0.50 mm.) containing several per cent of coarse sand; milky and pink grains common among the coarser grains are probably feldspars. All the grains are well rounded and many are spherical. Polishing is evident on all but the largest grains, which are frosted. These deposits are massive, and too poorly consolidated to stand in banks. Consequently, bedding characteristics are obscured. Banding described under Unit 6 in deposits of a sandy plain surrounding the Claypool site is probably not bedding; more likely, the bands represent temporary stands of vadose water which fell as rain on the deposits.

Age and correlation. Deposits of the sand hills at the Claypool site are comparatively unweathered and date from about 5000 years ago, if my conclusion as to the age of soil on the artifact-bearing sand is correct. The presence of these deposits suggests a climatic change, probably to warm-dry. Hill and Tompkin (1953: 33) assign the Sand Hills formation (Lugn 1934: 321, 322, 331, 350) in the Wray area to the late Pleistocene and Recent. The sand hills at the Claypool site are apparently part of the great dunal tract which extends eastward through the Wray area into Nebraska.

Alluvium

Between some ridges of the sand hills are grassy swales floored with sandy alluvium and containing small, ephemeral ponds. The drainage is not through-flowing but toward low, centrally-located areas. The alluvium is somewhat finer grained and more poorly sorted than the older deposits. It is covered with sod but lacks sage and yucca.

Summary

Algal limestone high in the Ogallala formation (Pliocene) crops out on ridges several miles west of the Claypool site, but the Ogallala is largely covered by deposits of Quaternary age. Gravelly sand at the base of the Claypool site possibly correlates with the Grand Island formation (Kansan) in Nebraska and Kansas, and marl in the top of the sand contains a molluscan fauna which resembles that of the Sappa formation (Yarmouth). A massive deposit of sand spread as a blanket a few feet thick unconformably overlies the older deposits and contains artifacts of the Cody complex. A moderately mature Brown Soil about 5 feet thick formed on the artifact-bearing sand prior to burial by dunes. The dunes extend eastward into Nebraska and are more or less stabilized. Alluvium occurs locally between dune ridges. Modern deflation has laid the stratigraphy bare. The artifact-bearing sand is regarded as a postglacial deposit, dating about 10,000 to 7000 years old. Its soil is thought to reflect the Thermal Maximum and is probably about 5000 years old.

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A HOHOKAM PLATFORM MOUND AT THE GATLIN SITE, GILA BEND, ARIZONA

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ABSTRACT

The mound near Gila Bend, western Arizona, excavated between November, 1958, and February, 1959 for the National Park Service by the Arizona State Museum, was rebuilt, modified, and repaired through six major stages of construction. The platform mound in use at any given stage was flat-topped and slope-sided with rounded corners and an irregular squarish or subrectangular outline. The platforms were made of a caliche plaster, and the sides were faced with a plaster of mixed caliche and adobe, placed directly over the earth core. Evidence of pre-mound occupation was encountered underneath the platform mound and in an excavated pit structure near the southeast corner of the mound. The entire historical sequence revealed by this excavation took place within the Sacaton phase of the Hohokam culture which may have lasted from A.D. 900 or 950 to A.D. 1100 or 1150 in the Gila Bend area. The significance of this Hohokam mound complex is that it represents a northern extension of the Mexican pyramid idea.

BETWEEN NOVEMBER 12, 1958, and February 28, 1959, a large mound at the Gatlin site was excavated for the National Park Service by the Arizona State Museum, under Contract No. 14–10–333–352, as part of the Inter-Agency Archeological Salvage Program and as the first phase of excavation in the salvage archaeology of the Painted Rocks Reservoir project. The Gatlin site has been designated as Ariz. Z: 2: 1 in the Arizona State Museum Archaeological Survey (Wasley 1957). It is about 3 miles north of the town of Gila Bend and about a mile south of the present Gila River channel (Fig. 1), in Township 5 South, Range 4 West, in Sections 17 (W½ of SW¼), 18 (SE¼ of SE¼), 19 (N½ of NE¼), and 20 (NW¼ of NW¼). The portion of the site on which the excavated mound is located is in the Section 17 area. This is State of Arizona land currently under grazing lease to Cole Gatlin, a local rancher whose courtesy, cooperation, and interest during the excavation were highly commendable. The remainder of the site is on lands belonging to the Gila River Ranch, Inc.

The Gatlin site is about one half mile long and one quarter mile wide, trending in a northeast-southwest direction along the first terrace above the flood plain of the Gila River at an elevation of 660 to 685 feet above sea level. In addition to the mound which was excavated, the Gatlin site consists of several trash mounds, cremation areas, two ball courts of the small, north-south, Casa Grande type (Gladwin and others 1937: 43), and sections of a prehistoric irrigation canal. Domiciliary areas are not identifiable from surface indications. Occupation of this prehistoric village was confined largely to the Sacaton phase of the Hohokam culture, which in the Gila Bend area may date from about A.D. 950 to 1150. Sherds belonging to the preceding Santa Cruz phase have been collected from the site, suggesting the possibility of slightly earlier beginnings for the occupation of the village, but no sherds of the Hohokam Classic period have been found.

Prior to excavation the mound appeared as a small hillock with a relatively broad top and relatively smooth sloping sides which were fairly steep only in the area of the northwest corner. This mound was essentially oval in outline, about 40 m. long and 30 m. wide, and it rose to a height of 2.5 m. above the surrounding terrain (Fig. 2). About a dozen holes made by vandals, a few of them quite large, marred the appearance of the mound. Strewn about the top and sides of the mound were potsherds and a large number of water worn river cobbles ranging from double fist size down. The latter were much more abundant on the sides of the mound than on the top. Dark, decomposed organic debris, charcoal, and ash, which usually characterize Hohokam trash mounds, were entirely absent in surface indications and in the pothunters' holes. In addition, there were too few sherds, and too many river cobbles, for the usual trash mound. Although it was reasonably certain that this was not a trash mound, the appearance of the mound presented no clue as to its specific nature, other than the fact that it was man-made and probably represented some sort of structure.

Thirty Years Too Late. The unusual nature of this mound — the fact that it was probably not a trash mound — was first noted in 1937 by Norton Allen, illustrator for *Desert Magazine* and a dedicated amateur archaeologist. By that time vandals from the Phoenix and Prescott areas had already thoroughly looted an extremely rich cremation area at the east side of this mound. Allen, over the intervening

FIG. 1. Map of Arizona showing location of Gila Bend.

years, has tracked down many of these people, has interviewed them, and has gone over their collections. From the information he has gathered in this manner, it would appear that between 60 and 80 copper bells, representing nearly half again as many as have previously been reported from the entire Southwest, came from this cremation area, along with an estimated 2000 projectile points and several whole vessels.

A single cremation might have been accompanied by up to 20 copper bells and up to 300 or 400 projectile points. Usually the projectile points had been burned in the cremation fire. This changed their color from the natural, translucent, almost transparent and nearly colorless chert to an opaque, milky white color. Points made of this material were characteristically long, thin and narrow, beautifully made (Fig. 3 *a*), and probably entirely ceremonial in function. A few projectile points of this type were found at Snaketown (Gladwin and others 1937, Pl. 86 *j*, *k*). A second type of projectile point, considerably shorter and made of a gray chert that is only slightly translucent (Fig. 3 *b*) also occurred with some of these cremations, but not in such quantities. Both types of projectile points seem, on occasion at least, to have been made in matched sets, so alike were all of the points in a single group.

The cremated bones of an individual were placed in the bottom of a pit which was usually cylindrical and occasionally as much as four or five feet deep. On top of the cremated bones and ashes were placed the grave offerings, sometimes completely filling the pit. In some of the cremations the projectile points were arranged in an orderly pile that produced a cribbed effect. The first layer of points would be oriented in one direction, the second layer at right angles to the first, and so forth until the pile was completed. Norton Allen encountered such an arrangement several years ago when he removed a cremation from a field that was being plowed over a portion of the site to the southwest of the mound. With this cremation was a Gallup Black-on-white trade vessel from the general Chaco-Puerco area of western New Mexico and eastern Arizona. Trade pieces from

FIG. 2. Platform mound in early stages of excavation. Looking south.

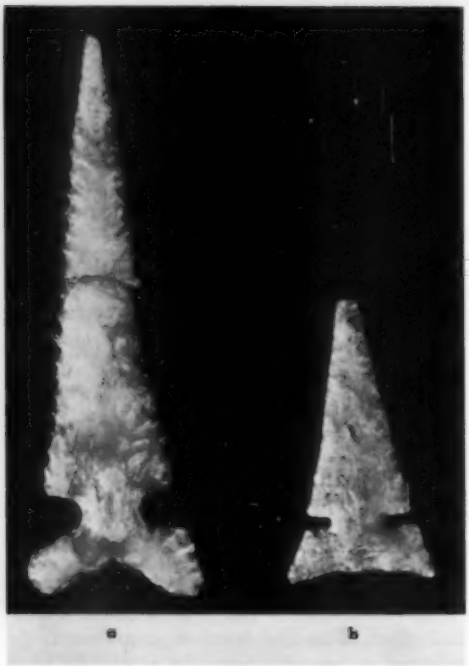

Fig. 3. Types of projectile points found in cremations. Length of *a* 5.9 cm.

northern Arizona occurred in some of the cremations. Most frequently represented were Tusayan Black-on-red and Black Mesa Black-on-white.

Environment

Except for the current agricultural development made possible by government subsidy, the Gila Bend area is typical of the lower semi-desert altitudinal range of the Basin and Range physiographic province. The valley floor is heavily dissected by the dendritic drainage pattern characteristic of this physiographic province. Vegetation on the Gatlin site now consists almost entirely of saltbush with some mesquite along the washes which have dissected it.

In this area of the Gila River the present channel is at the extreme north edge of the valley, so that agricultural lands, now as in the past, are to be found primarily on the south side of the river. To the north of the Gila River, opposite the Gatlin site, the Gila Bend Mountains rise almost directly out of the present channel, although there is a narrow shelf of flood plain and pediment in some areas on which small sites, mostly of a later period, are to be found. Until the construction of modern dams on the Gila and Salt rivers of Arizona, the Gila River was a perennial stream, carrying much needed water from the mountainous areas of the state to the desert dwellers. The great danger, before the construction of dams, was not lack of water but occasional heavy flooding. As late as 1928, after the first modern dams had been completed, the Gila flooded its banks in the Gila Bend area to a width of about half a mile, sometimes nearly a mile.

The importance of the Gila River to the prehistoric inhabitants of the Gila Bend area may be seen from an examination of local climatic conditions (Smith 1945). Average annual rainfall is about 6 inches. This falls in a period of some 17 days, with most of it coming during a single month (July, August, or September). The mean annual temperature is 72°F., but the extremes recorded are 11° and 123°. The mean daily temperature range is about 35°. The growing season, between killing frosts, averages about 290 days.

Excavation

Prior to excavation it was felt that the mound represented some sort of architectural feature, and it was wrongly assumed that this would involve vertical walls made of adobe, or of river cobbles and adobe, that extended down to about the level of the area surrounding the mound. Thus, in an attempt to locate the preserved basal portions of these walls, preliminary trenches about a meter wide were started away from the base of the mound on the north and west sides and were carried into the mound. These trenches eventually cut through some of the later facings and floorings of the platform mound, but this was not evident until they were viewed in profile. When it finally became apparent that inclined facings, and not vertical walls, had been encountered and that the mound might indeed represent a platform mound, the trench excavation was halted. The Papago laborers, who numbered from four to 13 during the course of the excavation period, were moved to the top and sides of the mound for stripping. Areas on top of the mound were removed in 3 or 4 cm. levels in an attempt to find the top of the platform.

As it turned out, the tops of two platforms were encountered at about the same time, sep-

arated by trash fill and a vertical distance of about 30 cm. The uppermost platform top was virtually at the surface of the ground in some places and nowhere more than 10 cm. below the top of the mound. Most of it had eroded completely away, leaving some areas in which it was possible to excavate down to the next lower platform top. The stratigraphic relationship of the two platform tops provided the first clue that the mound might consist of a series of superimposed platform mounds. Therefore, the procedure from here on was to try to follow and clear as much of each of the facings and platform tops as possible without seriously disturbing the overlying ones until they faded out or disappeared, and there to penetrate further into the mound in search of still earlier stages of construction. In this manner it was possible to identify four major stages of construction and to expose enough, or nearly enough, of each to determine its size and shape.

Eventually a point was reached at which it was necessary to decide how much of the later construction should be preserved at the expense of thereby being unable to reveal more of the earlier stages of construction. It was decided that as much as possible of each stage of construction should be left intact, and that in addition a small portion of the mound should be left entirely unexcavated. These decisions were reached on the basic assumption that at some future date it might be desirable to display this platform mound complex as a State or National monument. Somewhat less than a quarter of the mound at the southwest corner was left unexcavated.

In order to gain as much information as possible, to explore the very center of the mound, and to determine what — if anything — was underneath the mound, a trench 45 m. long and 2 m. wide was dug completely through the mound from northwest to southeast, in most places down to non-cultural deposits. The significant portion of this trench is shown in Figure 5, and the profile made along one face of the trench appears in Figure 6 (Profile A–B). This trench revealed three major points of interest: (1) a series of three modifications to Stage III, which up until then had been considered to be the earliest stage of construction; (2) two major stages of construction both earlier than Stage III; (3) evidence of pre-mound Sacaton phase occupation both beneath and adjacent to the mound.

Meanwhile, trenches on the north, west, and south sides of the mound were carried in some areas to a depth of about 3 m., at which point a buried stream channel was reached in the test pits in all three trenches. Flecks of charcoal occurred in the silt and sand all the way down to this depth, which was the reason for going so deep. While this charcoal may represent redeposition from an early cultural site farther upstream, it seems more likely that the charcoal in this otherwise sterile deposit underlying the Sacaton phase occupation was derived from brush fires in the general area upstream. An excavation made by vandals about 6 m. from the southeast corner of the mound, during the first weekend of the field season, revealed what appeared to be a heavily burned structure occupied prior to mound construction. This house, designated Structure No. 1, is described in a later section of this report.

At the conclusion of the field season the entire platform-mound complex and Structure No. 1 were backfilled for preservation. Before backfilling, the mound surfaces and the floor of Structure No. 1 were covered with 2 gauge polyethylene plastic sheeting. This was done in the hope that it would not deteriorate after it had been covered with dirt and that it would thus make re-excavation an easier task (Fig. 4).

STAGES OF CONSTRUCTION

Stage I

Although all of the top and most of the rest of the initial stage of platform-mound construction had been destroyed, partly by later construction and partly by extensive vandalism in this area, it was possible to gain some idea of the size and shape of the original structure. It appears to have been a single unit, subrectangular or oval in outline, about 10 m. long and 5 m. wide at the base (Fig. 5). On the basis of the portion of facing preserved on the north side, it seems likely that this small mound was about 1.0 m. to 1.25 m. high. There was no way of telling, of course, what features, if any, were on top of this platform.

This first mound was built on a prepared caliche "floor" or plaza surface. Earth, consisting of sandy silt that contained potsherds, was piled on this caliche surface, probably arranged into the desired shape, and the surface of the dirt pile smoothed. Then a plaster coat or facing made of mixed adobe and caliche was applied over the sloping sides of this dirt pile.

Fig. 4. Backfilling over the polyethylene plastic film.

The plaster facing, in the few places in which it was still preserved, varied in thickness from about 2 cm. to about 10 cm. and was fairly well smoothed. The platform top was probably covered with a caliche plaster in much the same way as the basal floor. There was evidence that this mound had been modified or repaired at the northwest corner, by the addition of a small area of refacing plaster.

One point should be made clear concerning the core of this and all of the subsequent construction stages. The earth carried in to build and periodically enlarge the platform mound contained cultural material, potsherds and occasionally some artifacts, during each of the construction stages. In a few instances it was quite evident that some of this material was brought from existing trash mounds. The important fact to bear in mind is that the actual time of any given stage of mound construction cannot possibly be earlier than the latest cultural material represented by general distribution throughout the core. Later cultural material may have been intruded at some other time in localized areas, as through vandalism and during periods of reconstruction. It is felt that reliable sherd samples were obtained from some areas for each of the stages of construction. On the other hand, it would be possible at the time of construction to include in the core of the mound sherds from much earlier time horizons. As it happened, however, there were only a very few sherds of Santa Cruz Red-on-buff, and these occurred in the cores of some of the later stages of construction.

Stage II

The second major stage of construction involved the use of Stage I as a nucleus and adding to it two large lobes and a third smaller one (Fig. 5). These lobes all had sloping sides and were built in the same way as Stage I. The two larger lobes may have been the same height as the Stage I platform mound, but the third one was probably lower. While the resulting slope-sided platform mound had two extensions to the north, it had lost any of the pyramidal effect that may have been apparent during Stage I. Actually, the reconstruction of the two larger lobes in Figure 5 may be entirely spurious, since in each case they are based on fragmentary facings on part of one side only. These lobes may have overlapped considerably, producing a somewhat more regular mound outline than has been suggested.

Stage III

During the third major stage of construction the platform mound of Stage I was retained,

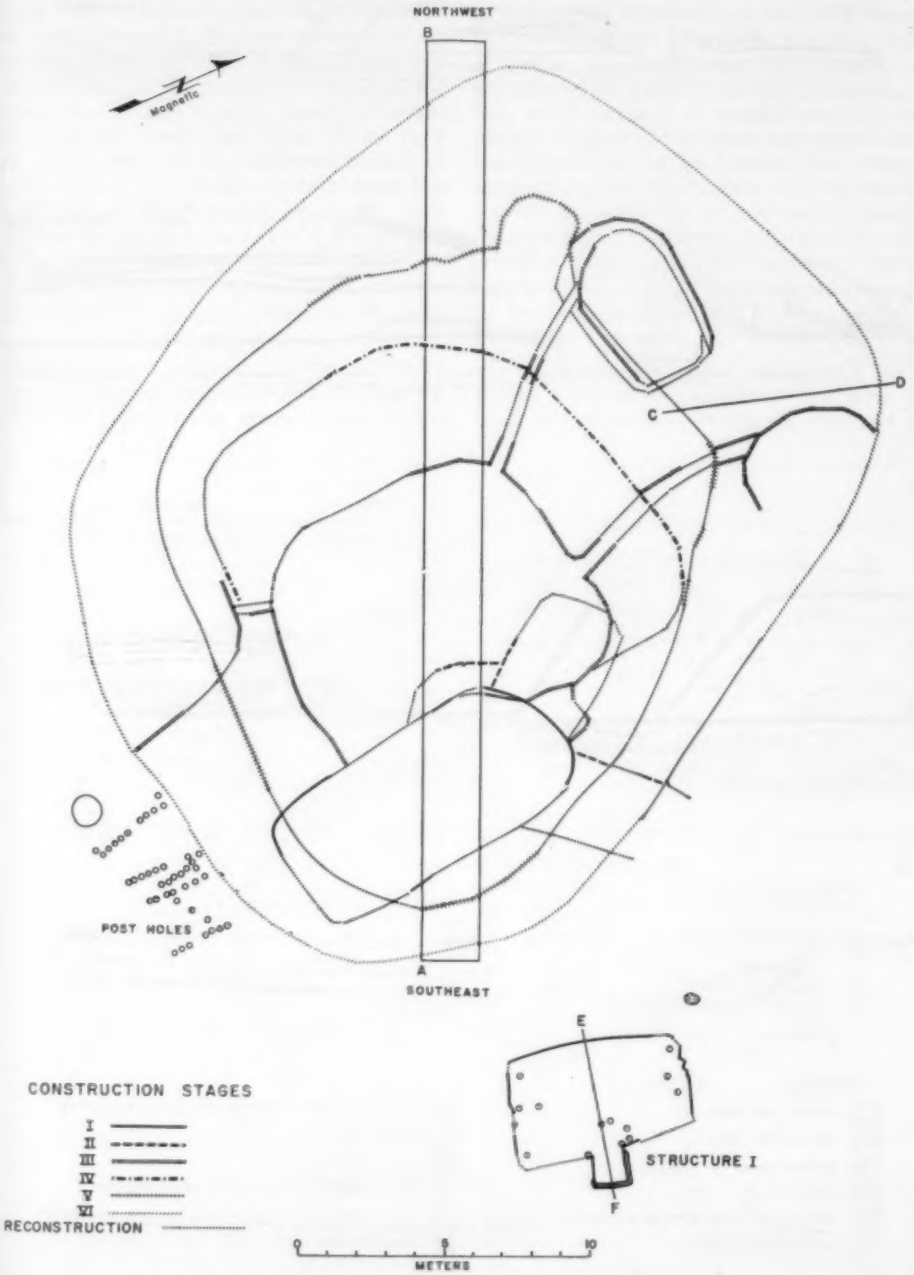

FIG. 5. Composite floor plan of the six stages of mound construction.

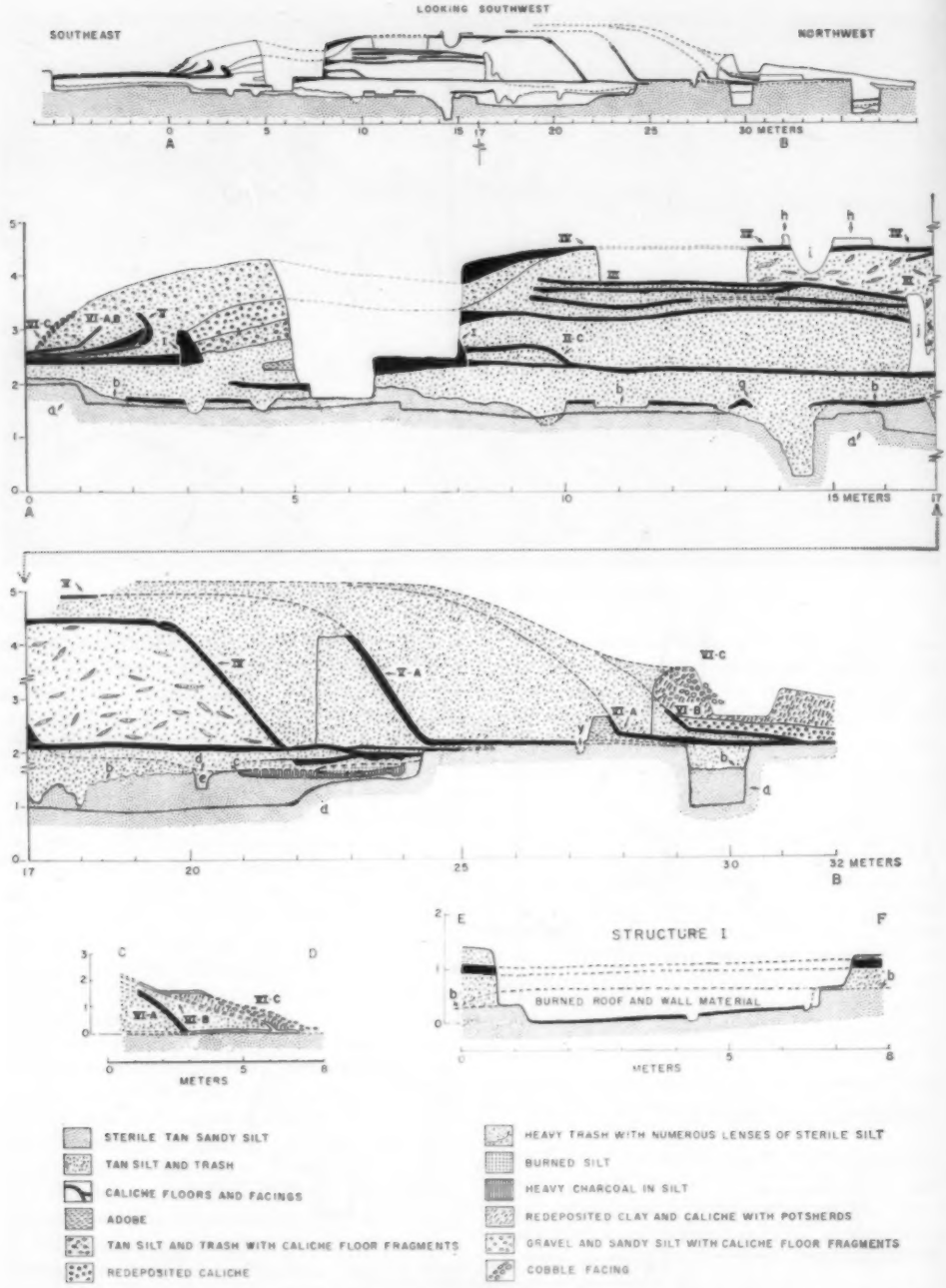

FIG. 6. Profiles through areas shown in Figure 5. *a*, bottom of trench; *b*, old ground surface; *c*, house pit; *d*, possible old surface; *e*, pit; *f*, post hole; *g*, rumbled hunk of caliche; *h*, raised clay dais; *i*, hole made by vandals; *j*, caliche retaining wall for Stage III.

probably intact, as a nucleus. The lobes added during Stage II, however, were largely destroyed and partly covered by the new construction, so that they were no longer a part of the new mound. This next construction involved the joining of a mound, roughly square in outline with rounded corners and about 10 m. on a side at the base, to the northwest portion of Stage I (Fig. 5). As it was originally built, this square mound was probably about the same height as the top of Stage I (Fig. 6, Profile A–B between meters 8 and 17).

While the two preceding stages and all of the following three stages of construction involved mounds with sloping sides and plaster facings, the main mound of Stage III was unique in being constructed with essentially vertical retaining walls of caliche mortar. Around the outer base of these walls an irregular step-like or buttress-like reinforcement was made, apparently as an integral part of the retaining walls. Whether this was done intentionally, to strengthen the walls, to produce a sloping effect, or to produce a stepped effect, is not known. Elements of all three suggestions could be observed in — or read into — the evidence, depending upon which portion of the feature was being examined. In any event, whether intentionally or otherwise, this feature actually served to reinforce the retaining walls. Various aspects of this feature may be seen in Figure 6 (*j*, between meters 16 and 17) and in Figure 7 (Profiles O–P, Q–R, S–T, U–V, and Y–Z).

The retaining walls were built directly on the caliche plaza surface extending out from the Stage II construction. While the tops and ex-

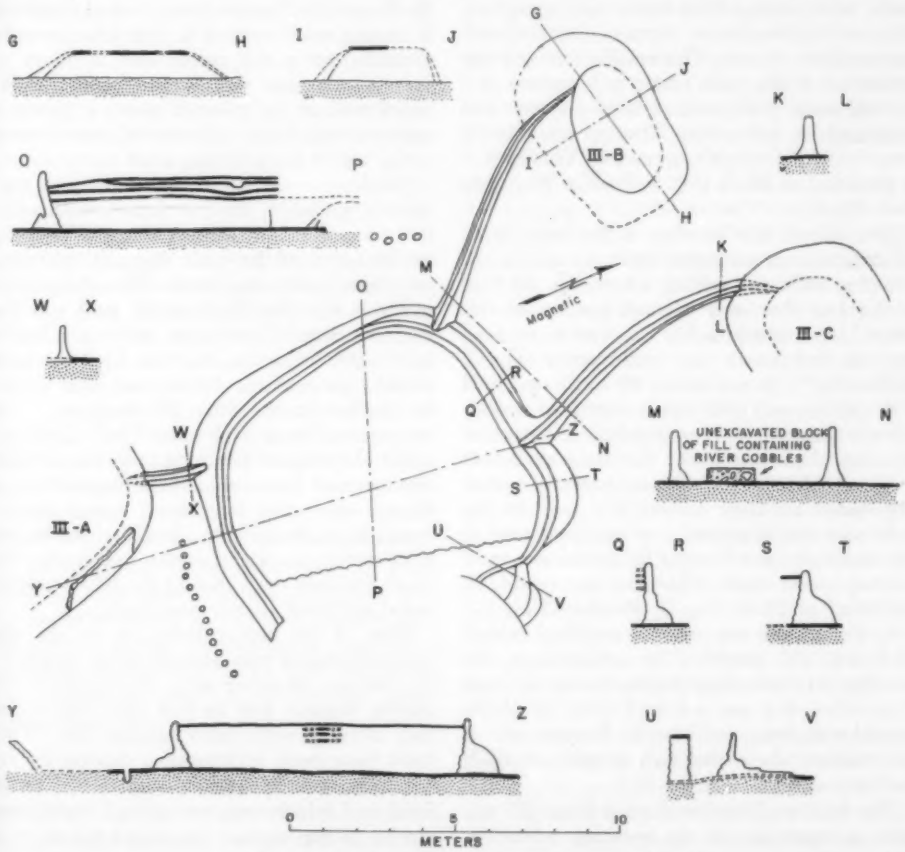

FIG. 7. Plan and profiles of Stage III construction.

terior sides of the retaining walls were finished smooth, the inner surfaces of the walls were not smoothed. It is possible that, in the process of construction, the retaining walls were built first, forming a hollow square into which the core material was dumped and packed. The top of this platform mound consisted of an essentially level floor of prepared caliche plaster. No evidence of structures or features was encountered on top of this mound, but only a very small area of it was exposed.

After some period of use a series of interesting modifications were made to the basic Stage III construction. First, the vertical retaining walls were raised, probably about 25 cm., a little more fill was added on top of the original platform, and a new caliche surface was laid. Probably at the same time, a completely separate, small and not quite so high a mound was built, with sloping sides faced with mixed caliche and adobe plaster, opposite the southwest corner of the mound. This ancillary mound was connected to the main platform by means of a vertical radial wall made of caliche mortar and smoothed on both sides. The top was slightly rounded in the smoothing process. This feature is identified as III–A (Fig. 7, Profiles W–X and Y–Z; Fig. 8).

The second modification of the basic Stage III construction consisted again in raising the retaining walls and adding a new top. In spite of the fact that only a small portion of this mound top was exposed by excavation, an oval, basin-shaped hearth was encountered (Fig. 7, Profile O–P). It was about 40 cm. long, lined with caliche, and although it contained neither ash nor charcoal, it showed definite evidence of burning. Again, at about the same time that these modifications were taking place, a new slope-sided ancillary mound was built to the northwest of the mound and was connected to the main platform mound by means of a new vertical radial wall. This ancillary mound is identified as III–B (Fig. 7, Profiles G–H, I–J, K–L; Fig. 8). In this instance ancillary mound III–B was also modified by enlargement, but whether this took place during the use of Stage III or whether it was not until Stage IV of the mound complex is not known. For the sake of convenience alone the enlargement of III–B has been assigned to Stage III.

The final modification during Stage III was again a repetition of the previous additions, with ancillary mound III–C built to the north of the main platform mound (Fig. 7, Profiles K–L, M–N; Fig. 8). The reason for believing that the ancillary mounds and their corresponding radial walls were built in the order given rests on the fact that, in the order they have been presented, each of the radial walls was higher than the preceding. The last two radial walls, to III–B and III–C respectively, sloped downward from the main mound to the lower ancillary mounds, while the radial wall to III–A was nearly horizontal. Finally, the top of the III–C radial wall, at the point at which it joined the main mound, was at exactly the same elevation as the top of the retaining wall.

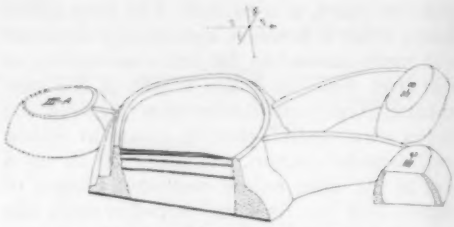

Fig. 8. Hypothetical reconstruction and cutaway of Stage III.

While this sequence of construction seems entirely probable, the correlation of the ancillary mound–radial wall sequence with specific modifications of the basic Stage III structure is somewhat more conjectural. Here the only certainty is that the III–C radial wall was built after the Stage III retaining walls were built to full height. However, this may have been after abandonment of the fourth and final mound-top surface on the Stage III structure. It will be seen in Figure 7 (Profiles O–P, Q–R, S–T, and Y–Z) that the retaining walls extend above the more or less level caliche mound top, as though they may have been raised again in anticipation of raising the height of the mound. If this were the case, then the modification was never finished, even though the III–C unit and radial wall had already been built.

Most of the final caliche top on the basic Stage III mound was cleared during excavation. No features whatever were encountered. This caliche surface was broken near the eastern end, along a remarkably regular line. There must have been an extensive digging by vandals in this area several years ago which was refilled and which was not noticed from examination of the surface. Scattered pieces of caliche flooring covered a wide area east of this

break and extended to some depth. In this area also were encountered the corroded brass portion of a shotgun shell about a meter below the surface of the mound at this point, and a piece of textile, probably rubber impregnated web belting, below the base of the Stage I construction. This destruction of the Stage III mound-top surfaces, and perhaps also of the top of the Stage I mound, has made it impossible to determine the exact relationships of the several basic Stage III mound levels to the original top of the Stage I mound. Thus, eliminating the problems presented here, Figure 8 represents a partial and somewhat theoretical reconstruction of the platform mound as it appeared at the end of the Stage III use.

One feature of Stage III remains to be described, but it cannot be reconstructed or fully explained. In the caliche plaza floor on which Stage III was built, and extending around the main structure at a distance of about 1 m. to 2 m. from the base of the platform mound was a row of post holes. These were encountered, specifically, only on the south side and opposite the northwest corner (Fig. 7). Excavation was not carried out far enough from the base on the north side to reveal them (because of the necessity for preserving the Stage IV facing on that side), and the west side was not excavated at all, but it is probable that this row of post holes encircled the mound on all sides except possibly the east. During excavation rotted, unburned wood was found in or over some of these post holes, and in one instance the rotted wood of a post extended up to the height of the top of the final Stage III platform mound on the south side. These posts were merely covered over and buried by the Stage IV construction, since apparently no attempt was made to remove them. These post holes were spaced from 15 cm. to 30 cm. apart and were about 20 cm. in diameter. What function the posts served is not known. They may have been part of a stockade around the mound; perhaps they supported a roofed colonnade, or enclosed a passageway open at the top; they may have served solely as trophy poles. Perhaps other explanations could be offered.

Stage IV

The central unit of Stage III was completely covered by the Stage IV construction, providing the first clear example of superposition. The resulting main platform mound again was roughly square in outline with rounded corners. It measured about 14 m. across at the base and rose 2.4 m. above the caliche plaza surface on which it was built. The top of this mound was 60 to 70 cm. above the top of the last Stage III platform and was made of caliche. The sloping sides were faced with a plaster that contained considerably more adobe than caliche. In some areas, particularly on the north side, the sloping sides had considerable curvature (Fig. 9). The core fill used in the Stage IV construction was particularly loose and unstable. On the north and northwest sides and in the central area above the Stage III platform it consisted of great quantities of organic trash and potsherds, probably from a trash mound. This material was interspersed at intervals by basketfuls of sterile silt which were dumped in. In the southeast area a considerable amount of loose gravel contributed to instability. In spite of the looseness of this core, in the areas in which Stage IV construction was still intact, the preservation was remarkably good. Near the base of the core on the north side several basketfuls of cobbles had been dumped in for core material.

The over-all growth of the total mound complex was to the west and north, particularly at the expense of earlier construction on the east and in the southeast corner (Fig. 5). This trend became more pronounced from Stage IV on, and the picture was further complicated by the extensive vandalism in the southeastern area mentioned earlier. As a consequence, it has not been possible to piece together the construction history in much of this area. The Stage IV construction may have completely covered Stage I without damaging it, but on the other hand part of the Stage I mound may have been destroyed in the process of Stage IV construction. There was some indication that there may have been a trough ramp extending from the southeast corner along the south side of the mound to give access to the top of the Stage IV platform (Fig. 10, Profile CC–DD). However, it has not been possible to determine that such a ramp really existed. Unfortunately, there were two other excavations by vandals in this area.

The three small ancillary mounds were preserved during the Stage IV contruction and presumably continued in use. As was pointed out earlier, the modification of ancillary mound III–B may have taken place at this time. The first and third radial walls were also maintained

intact, with the Stage IV construction merely passing over them. For some unexplained reason the radial wall to ancillary mound III–B was truncated at the facing of the Stage IV construction and no longer connected with III–B. During the construction of Stage IV, a new and probably enlarged plaza area of prepared caliche was built around the base of the mound. On the north and northwest sides of the mound, at least, a new row of posts was set into the plaza floor paralleling the base of the mound at a distance of 1 to 1.5 m. The post holes opposite the northwest corner were spaced about 25 cm. apart, as in Stage III, but those on the north side of the mound were spaced about 1 m. apart. Above some of the post holes on the north side were again preserved unburned fragments of posts extending to a height not quite equal to that of the top of the mound.

The most interesting aspect of the Stage IV construction were the features on top of the platform (Fig. 10). A slightly irregular post hole pattern suggests that there was some sort of rectangular structure, probably of jacal construction, facing south. The shape and proportions indicated by these post holes corresponds quite closely to that commonly found in domestic pit structures of the Sacaton phase. This

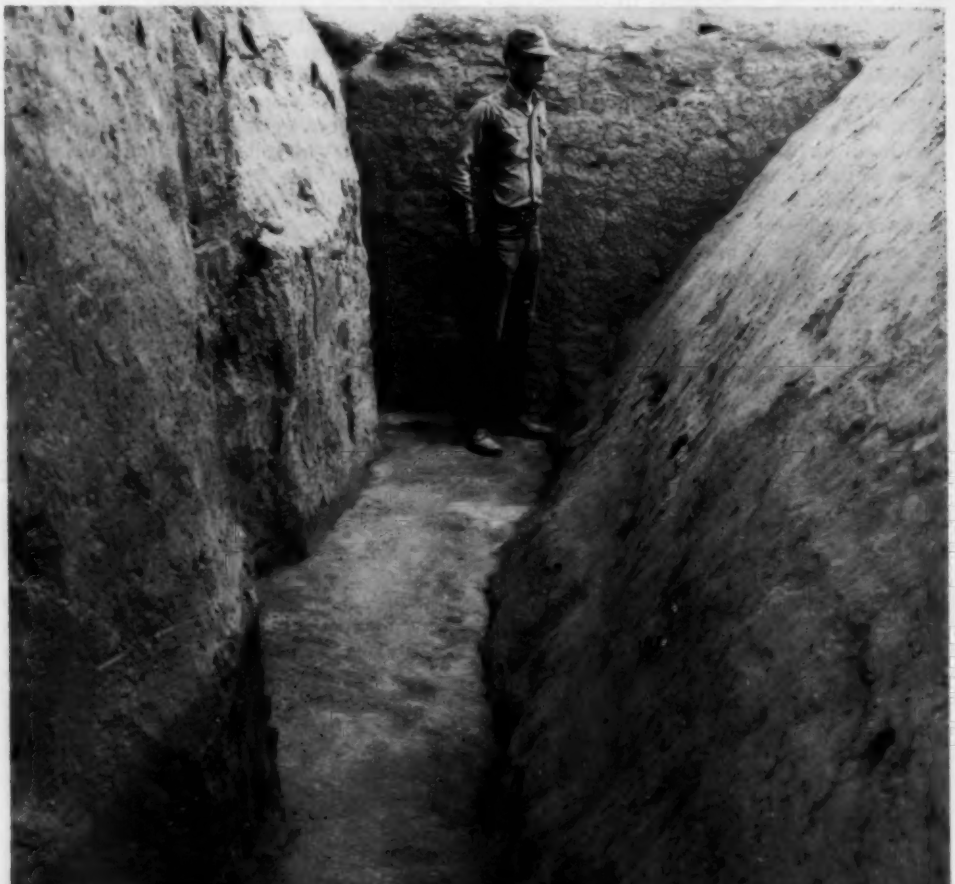

Fig. 9. Stage IV. The north facing is at the right, and the radial wall to III–C is at the rear. The bank at the left represents core material supporting the facing of Stage V.

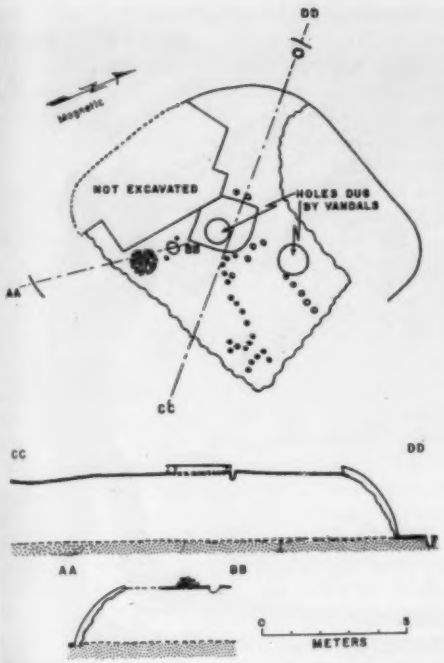

FIG. 10. Plan of platform top and profiles for Stage IV.

structure was about 2 m. wide and was probably close to 6 m. long, although the eastern end was not preserved. A raised dais or small platform made of nearly pure clay was encountered at the west end of the post hole outline. The top was smooth, showed evidence of burning, and was 25 cm. above the main platform top. A hole dug by vandals penetrated through the top of this dais. None of the edges of this dais were identified, so that the shape shown in Figure 10 is not entirely correct. This dais may have been square or rectangular, extending westward from the west wall of the jacal structure. Just south of the dais was a basin-shaped hearth 40 cm. in diameter and lined with caliche. It contained no ash or charcoal, but the sides and bottom showed evidence of burning. Two small post holes flanked this hearth on the northwest and southeast sides. About 60 cm. south of the hearth was a pile of river cobbles, showing no signs of burning, and giving no other indication of their probable use. After it had been cleared, a part of the platform along the east side was removed during excavation to expose more of the underlying Stage III construction.

Stage V

The fifth stage of construction also expanded the mound mainly to the north and west and crowded upon earlier construction on the south and east sides. It completely covered the main mound of the Stage IV construction, probably removing part of the southern and eastern portions in the process. The core fill of Stage V was much more compact than that of Stage IV and contained fewer potsherds. During the process of building up this core, some of the prehistoric workmen probably built a simple hearth on the then existing surface of the core, on the north side of the mound. They probably cooked a few meals, or warmed themselves on cold mornings, until this hearth was finally covered over in the process of finishing the mound. The general shape of the Stage V construction was similar to that of Stage IV, but the outline was even less regular (Fig. 5), there were more resurfacings and repairs to the sides, and the plaster used on the facings was of a poorer quality (Fig. 11).

The Stage V enlargement of the platform mound finally encroached upon small portions of ancillary mounds III–A and III–B, but they were not destroyed and may still have served some purpose. There was no encroachment upon ancillary mound III–C, and the short portion of radial wall between the Stage V facing and this unit was not removed or damaged while the Stage V structure was in use. There may have been a ramp, coming straight up the north side of the mound, passing over and covering, or maybe incorporating, ancillary mound III–B. However, once again the evidence for a ramp was so fragmentary and indefinite that there is no certainty in its existence.

An unexplained feature of this mound is a low sloping lobe of caliche-adobe plaster at the northeast corner of the mound (Figs. 5, 11). A series of post holes coursed up the spine of this feature to its juncture with the eroded facing of the main Stage V mound. Opposite the northwest corner of the mound, but not visible in Figure 11, was a row of post holes parallel to the base of the mound. There were also post holes opposite the northeast corner of this mound, indicating that the Stage V platform mound may have been surrounded by posts. A new caliche plaza surface was also added during Stage V.

The platform top of Stage V was the highest found. In some places it was barely beneath

Fig. 11. Facing of Stage V. Looking eastward across northwest corner of mound.

the surface of the ground, and of course it was disturbed by all of the vandalism on top of the mound. Consequently, only patches of it were encountered during excavation. However, it was possible to determine that it had been repaired or resurfaced two or three times, by the addition of a new caliche plaster coat placed directly on the older surface. In one area of this platform top there was a small pile of cobbles. No other features were discovered. This platform top was about 2.75 m. above the plaza floor. The Stage V platform mound was about 20 m. long and 18 m. wide at the base.

Stage VI

During the sixth and final major stage of construction the base of the platform mound was enlarged three different times. In the first phase of this work the Stage V construction was completely covered, and in the process it was partly destroyed on the east and south sides. Most of ancillary mound III–A was also covered by this enlargement of the platform mound, and the portion that was not covered was destroyed at this time. Ancillary mound III–B had already been enveloped by the Stage V construction, and this next enlargement of the mound came up to ancillary mound III–C in the northeast corner, but this small mound was not destroyed. The mixed caliche and adobe facing over the core material sloped at a flatter angle than in any of the preceding stages of construction (Fig. 6, Profile A–B, between meters 25 and 28). None of the platform top of the Stage VI construction was preserved, but it probably was about 25 to 30 cm. above the Stage V platform and would have made the Stage VI mound about 3 m. high. A new plaza surface extending out from the base of the mound was also added at this time. In it, on the north side and possibly also on the east side, were post holes roughly paralleling the base of the mound, as during previous periods of construction.

The second phase of Stage VI construction involved the extension of the base of the mound northward for a maximum distance of about 3 m. and flattening the slope of the facing even

more (Fig. 6, Profile C–D). This new facing on the north side and on the north ends of the east and west sides merged with the original Stage VI facing somewhat below the top of the mound. In the area of the northwest corner of the mound, but apparently not along the rest of the north side or in the area of the northeast corner, the plaza surface was also rebuilt at this time. When this facing was added, what remained exposed of ancillary mound III–C was probably destroyed. The south side of the mound and the southern ends of the east and west sides do not appear to have been affected by the second phase of Stage VI construction.

Finally, a facing of river cobbles was laid around the base of the mound as the third phase of Stage VI remodeling. The cobble facing extended up the sides of the mound for a vertical distance of about 1.0 to 1.5 m. (Fig. 6, Profiles A–B between meters 28 and 30, and C–D). Along the north side and the north end of the east side of the mound, it appeared that a definite stepped pyramidal effect was achieved which may have extended all the way around the mound. This final modification gave the platform mound its greatest size. It was now about 29 m. long and 22 m. wide. This nearly rectangular outline of the Stage VI construction is the one shown in Figure 5.

There was no evidence to indicate that new ancillary mounds, farther away from the base of the platform mound, had been built to replace those enveloped or destroyed by the progressive growth of the mound. Neither was there evidence, after the addition of the cobble facing, that posts had been set around the mound as in previous stages of construction. On the other hand, an entirely new alignment of posts was built in the plaza area to the south of the mound (Fig. 5). The only regularity in this consists of rows of closely spaced posts at right angles to the base of the mound, but this regularity is broken by the uneven spacing of these rows and by the addition of a few other posts forming no regular pattern at all. While the purpose served by these posts is highly conjectural, it seems unlikely that they were incorporated into any sort of structure, and somewhat more likely, therefore, that they may simply have been posts on which trophies were placed, or impaled.

To the west of these post holes, and still in the plaza area, was a bell-shaped storage pit (Fig. 5). This pit, as well as the post holes just mentioned, were built into the plaza surface in use after the latest Stage VI construction of the platform mound. The storage pit was about 1.25 m. in diameter at the top, about 1.65 m. in diameter at the bottom, and 1.75 m. deep. The sides were very poorly preserved. In the bottom of the pit and at one side was a pile of river cobbles. It is not known, absolutely, how far out from the platform mound the plaza surfaces extended. On the north and west sides the plaza has been truncated by recent sheet erosion. On the south and east sides it fades out at distances from 15 to 20 m. out from the final Stage VI base of the mound.

PRE-MOUND OCCUPATION

Occupation of the immediate area of the platform mound prior to any of the Stage I period of construction was revealed by excavation in an area a few meters to the southeast of the mound and by the long trench excavated through the mound. This occupation took place on a somewhat irregular ground surface identified as *b* in Figure 6 (Profile A–B).

Structure 1

During the first weekend of the field season a vandal dug a hole opposite the southeast corner of the mound. Examination of the sides of this hole revealed that it had penetrated (1) through the plaza sufaces, (2) through a fill that included a considerable amount of heavily burned material including fragments of roof or wall plaster, and (3) through another caliche floor about 1.25 m. below the surface of the ground. Subsequent excavation in this area by the field crew uncovered a shallow pit house which has been designated as Structure 1.

This pit house (Figs. 5, 12) was essentially rectangular in outline with a short lateral entry culminating in a step at the outer end (Fig. 6, Profile E–F). The structure was 6.0 m. long and 3.8 m. wide, and it was oriented with the entry to the east. Between the lateral entry and the center of the structure was a circular, basin-shaped fire pit (Fig. 12). The floor of this house was made of a caliche plaster which was poorly preserved in some areas. The side walls of the house pit were also plastered with caliche, but surfaces of these walls were identifiable only where the plaster had been preserved by burning. At some points the limit of the structure was determined by finding the edge of the floor. Around the edge of the floor post

Fig. 12. Structure 1. Looking north; the basin-shaped hearth is being indicated.

holes were encountered, but there were probably more of them than it was possible to find during excavation. There was no evidence of a trough around the walls of this house. However, a shallow trough was encountered along the north and east edges of the rectangular ramp entry. This contained quite a bit of mesquite charcoal. No evidence of the trough could be found on the south side of the ramp. Near the fire pit were two small circular floor pits, possibly used for storage.

Apparently Structure 1 was abandoned for a while, during which time a culturally sterile, laminated silt deposit 1 to 2 cm. thick was washed in. Structure 1 then caught fire, or was set afire, and burned with a fairly intense heat. The silt deposit was covered with up to 50 cm. of heavily burned roof and wall plaster, and the ground outside the north end of the house was burned a reddish color, in some places to a depth of 4 cm. Mixed in with this roof and wall material, indicating that they may have been on top of the roof or hanging from the ceiling, were a mountain sheep skull and several mountain sheep horn core and skull fragments, probably representing at least four or five individuals. These were also burned to a greater or lesser extent.

After the structure had been destroyed by fire, a layer of silt and trash accumulated over the area to a depth of about 30 cm. Into this deposit, whether during or after its accumulations is not known, was intruded a cremation burial which extended 15 cm. into the burned roof and wall material. The cremated bones of an infant or a small child had been placed in a tiny Sacaton Red-on-buff jar 5.5 cm. high and 7.8 cm. in maximum diameter (Fig. 13 *b*). Associated with this cremation was a large unworked *Cardium* shell, a carved stone bowl (Fig. 13 *a*), a large sherd from a Gila Plain jar, and a river cobble. Over the top of this deposit was built the succession of plaza surfaces associated with the various stages of platform mound construction. In the vicinity of the house these surfaces formed a layer 20 cm. thick at the west side of the structure and 15

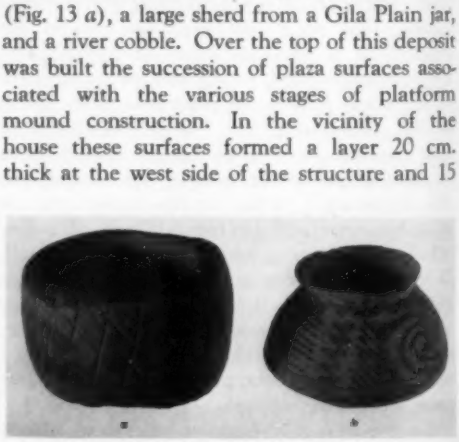

Fig. 13. Artifacts from cremation in Structure 1. *a*, stone bowl; *b*, Sacaton Red-on-buff jar. Diameter of *a*, 9 cm.

cm. thick at the east side. This layer served as a seal over the earlier deposits. On top of the plaza surfaces was a thin layer of silty material containing potsherds and representing primarily wash from the sides and top of the platform mound after its abandonment.

Structure 1 was occupied during the Sacaton phase, but probably early in the period. The 51 sherds found on the floor included seven Sacaton Red-on-buff (of which three were from the same vessel), two sherds which could have been either Sacaton Red-on-buff or Santa Cruz Red-on-buff, six Sacaton Buff, and the remainder Gila Plain (Gladwin and others 1937: 171–85, 205–11). On the basis of architecture Structure 1 could have been either late Santa Cruz phase or early Sacaton phase (Gladwin and others 1937: 79). The combination of the ceramic and architectural evidence suggests early Sacaton phase for the occupation of the house.

Evidence from the Trench

Pre-mound occupation of the area underneath the platform was revealed by the long trench excavated through the center of the mound (Fig. 5). A small portion of a burned pit house was encountered underneath the northwest corners of construction Stages IV and V. This structure is indicated as c in Figure 6 (Profile A–B between meters 21 and 24), and it was built from the old ground surface, *b*, which was beneath all of the plaza surfaces of the mound. The house pit of this structure contained a considerable amount of fine charcoal mixed in with the silt fill. Three post holes were found in the small portion of the floor that was exposed. This structure must have been occupied at about the same time as Structure 1. Several patches of a plastered caliche surface or floor were encountered underneath the plaza surfaces of Stages I and II (Fig. 6, Profile A–B between meters 10 and 17). Apparently an irregular pit or excavation had been made through this surface in prehistoric times. Other fragments of caliche surfaces underlying the mound construction were encountered near the southeast end of the trench (Fig. 6, Profile A–B between meters 2 and 6).

POTTERY AND ARTIFACTS

A complete and detailed description of the pottery, sherd counts, and artifacts will not be attempted. However, a few general statements concerning the pottery and brief descriptions of a few of the artifacts are warranted.

Pottery. The frequency of the pottery types in the sherd counts of the various excavation units was fairly constant. The total sherd count was 20,645. About 99% of the pottery was represented in three types: Gila Plain (72%), Sacaton Red-on-buff (14%), and Sacaton Buff (13%, probably representing a high proportion of sherds from the undecorated bottoms of Sacaton Red-on-buff jars). The remaining one per cent of the sherds included local minority types (Sacaton Smudged and Sacaton Red), pottery types from earlier phases (Gila Butte Red-on-buff, Santa Cruz Red-on-buff, and Rillito Red-on-brown), and all intrusives representing trade with other areas (Valshni Red, unidentified brownware and redware sherds from the south or east, Lower Colorado River Buff Ware, Wingfield Plain, Deadmans Fugitive Red, Holbrook Black-on-white, Black Mesa Black-on-white, Deadmans Black-on-red, and Tusayan ? Black-on-red).

There was some suggestion that Sacaton Red was more plentiful in the later stages of the mound fill than in the earlier ones. Otherwise, there was no definite indication of ceramic trends during the history of the platform mound and the pre-mound occupation of the immediate area. Two variations from the norm in the treatment of Sacaton Red-on-buff were noted. A very thin white slip, as opposed to the usual buff wash, was applied to about 50% of the Sacaton Red-on-buff sherds. Polishing over the decoration was apparent on about 13% of Sacaton Red-on-buff. This latter treatment is quite similar to that ordinarily seen on the Rillito Red-on-brown and Rincon Red-on-brown sherds from sites in the Tucson area, but in this case the pottery so treated was in all other respects Sacaton Red-on-buff.

Copper Bells. Mention has already been made that copper bells occurred in relative abundance in the burials of the looted cremation area on the east side of the mound. In addition, three copper bells were encountered during excavation (Fig. 14). These were of the small, globular or spheroidal shape characteristic of copper bells found in other areas of the Southwest at this same time horizon (Gladwin and others 1937: 164, Pl. 133 *a*). The Gatlin site specimens average 1.5 cm. in length and 1.2 cm. in width. Each has a slit in the bottom of the resonator and a copper pellet clapper. Eyelets at the top of the bells are at right angles to the slits in the resonators. Two of the eye-

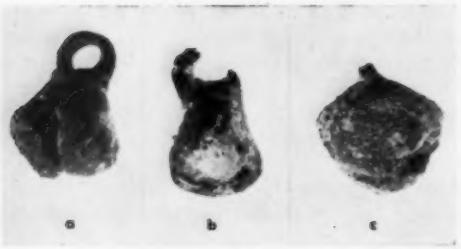

Fig. 14. Copper bells. Diameter of *a*, 1.3 cm.

lets are broken. It is now generally agreed that copper bells were manufactured in Mexico and reached the Southwest by prehistoric trade (Hawley 1953: 101–3; Rinaldo 1959: 275–6). Two of these three copper bells were incorporated in the core material of the platform mound, but in areas in which it was not possible to determine the specific stage of construction. The third one was found in Structure I in the layer of burned roof and wall material.

Chipped Stone Blades. One complete blade (Fig. 15) and a fragment of another were found in the core of the fourth stage of mound construction. The complete specimen was made of a milky white chert and measured 14.4 cm. long and 4.5 cm. wide at the base. It exhibits fairly good chipping and symmetry of construction. The base has been thinned and is slightly concave. The other blade fragment is slightly grayer in color and has a maximum width of 4.5 cm., although it represents a section somewhat above the base of the blade.

Carved Stone Vessel. Associated with the cremation in Structure 1 was a round sandstone bowl with a slightly convex bottom and straight sides. It is decorated on the outside with an incised cross-hatched design (Fig. 13). The parallel lines in each set forming this design are about 1.5 cm. apart. The cross-hatching forms a series of diamonds covering the exterior of the bowl. Characteristic of the Sacaton phase is the crude workmanship and the simplicity of the design. The wall thickness of this vessel varies from 1.2 cm. at the rim, which is flat, to 1.6 cm. near the bottom. The bottom of the bowl is about twice as thick as the walls. Stone bowls of this type may have been used as incense burners. The bottoms of some of them are caked with some sort of burned material. In this instance no cake was apparent, although the bottom shows signs of burning.

Wooden Paddle. A paddle-shaped artifact, carved out of ironwood, was incorporated in the core material of the fifth stage of mound construction. It is 21 cm. in length and 6.2 cm. in maximum width. The handle is 11.5 cm. long, and the maximum thickness, which is found in the handle, is 1.3 cm. Thickness of the paddle blade is 9 mm. This object is only slightly charred. The broad end, in particular, and the lateral edges of the paddle blade, to a lesser extent, have not been well preserved. It is therefore impossible to tell if the broad end had been beveled, and it does not appear that the lateral edges were beveled, although they may have been slightly rounded. The blade of the paddle seems to have one slightly concave surface, but this may be a result of weathering and deterioration rather than of original manufacture. Similar paddle-shaped objects have been found in Hohokam sites of this and later horizons (Haury 1945b: 162–3, 170, 178, 182–3, Pl. 74). While some paddles of this general type may have been used in the manufacture of Hohokam pottery, Haury (1945b: 162–3) points out that modern pottery paddles used by the Pima have a slightly different shape, and he suggests that the archaeological specimens may have served as hand digging tools.

Dating

The ceramic complexes for the pre-mound occupation and for the construction and use of the platform mound, throughout the six major

Fig. 15. Chipped stone blade. Length 14.4 cm.

building stages, indicate that all of this prehistoric activity took place during the Sacaton phase of the Hohokam culture. No datable tree-ring material was obtained during the excavation, and although samples of charcoal for dating by the radiocarbon method were collected, these have not yet been processed. At present the dating of the Gatlin site must be based on ceramic cross-dating, associated artifacts, and stratigraphic sequence of events. At Snaketown the Sacaton phase was dated, largely on the basis of trade sherds from northern Arizona (Gladwin and others 1937: 212–20), from A.D. 900–1100, since the Sacaton phase appeared to be approximately equivalent in time to Pueblo II in the Anasazi area where pueblo ruins of this period have been dated by the tree-ring method. The most reliable ceramic cross-dating at Snaketown was for the Sacaton phase. Intrusive pottery at the Gatlin site merely supports this broad correlation of the Sacaton phase with Pueblo II, with Black Mesa Black-on-white, Holbrook Black-on-white, and Deadmans Black-on-red being the key pottery types in making this equation. The type of copper bell found at the Gatlin site further supports this correlation. The actual dates for the Sacaton phase in the Gila Bend area may be around A.D. 900 to 1100 or 1150, or somewhere within this range, but probably no earlier or later.

The sequence of events at the Gatlin site within the Sacaton phase, as it has been revealed by the excavations, permits a relative chronological placement of the platform-mound construction, use, and abandonment. A period of time at least somewhat early in the Sacaton phase, and of unknown duration, was taken up by the pre-mound occupation and the subsequent temporary abandonment of the immediate area of the platform mound. Another segment of time, perhaps of longer duration, was required for the use of the platform mound during its history of six major stages of construction and numerous phases of modification and repair. Finally, the platform mound, and the entire Gatlin site, were abandoned sometime before the end of the Sacaton phase. This suggests that the entire history of the platform mound was probably compressed into a period of no more than 100 years within the Sacaton phase.

DISCUSSION

The ceremonial function and importance of the platform mound at the Gatlin site are indicated partly by the rich cremation area adjacent to the mound and by the labor force necessarily recruited for the construction and maintainance of the mound. Evidence from the platform mound itself lends support to the idea that its use was ceremonial: periodic enlargement and modification, the construction of radial walls and ancillary mounds, and the unusual post hole alignments. There was no evidence that the platform mound had been built over a tomb or over a burial of special significance. The long trench was placed through the mound in such a way that it should have disclosed anything of this nature, and further excavation widening the trench on either side in the area of the earliest stages of construction likewise produced negative evidence.

The significance of this platform mound complex is that it reflects a northern extension into the Hohokam area of the pyramid idea found in many of the prehistoric cultures in Mexico. While this is the first ceremonial platform mound to be excavated in the Hohokam area, it merely corroborates other lines of evidence which point to the considerable influence of Mexican cultures on the Hohokam of southern Arizona. These have been summarized by Haury (1945), and while new hypotheses and supporting evidence have been added in recent years, this core of evidence has not been altered substantially. If this were the only occurrence of ceremonial platform mounds in the Southwest, it would indeed be unique. One must now expect that others will be found, and it should be kept in mind that some of the platform mounds belonging to the later Classic Period of Hohokam may represent a somewhat different manifestation of the basic Mexican pyramid idea.

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FACTS AND COMMENTS

REPLY TO MACNEISH

WALTER W. TAYLOR

ABSTRACT

In a rejoinder to Taylor's review of his Tamaulipas monograph, MacNeish restated his method of analysis and reviewed the system he used to establish his phase sequence. Taylor claims that MacNeish has defended his position by introducing new data and by presenting a point of view not expressed in the original monograph. Taylor insists that MacNeish's reply only confirms his original criticism that the Tamaulipas sequence is built on the premise that one excavation unit equals one phase.

I DO NOT BELIEVE that a scientific journal is a place to make *ad hominem* remarks — or to reply to them. Therefore, I do not intend to deal with certain of the statements and implications contained in MacNeish's *Rejoinder* (1960) to my review (Taylor 1960) of his Tamaulipas report (MacNeish 1958). On the other hand, I do believe that a scientist has the right, even the obligation, to defend his statements, particularly against charges which seem to be based on maltreatment of the evidence. On this premise, then, I should like to discuss the major points raised by MacNeish, in order to set the record straight and to vindicate my "ability to analyze archaeological materials," upon which he has cast his doubt. This will be an analytic study in its own right, not merely and solely a rebuttal. As such, I hope it may prove both informative and illuminating.

MacNeish rejects my contention that one of his major premises was that "if it is one deposit according to his own way of thinking, then it is one phase, even one band, even one occupation," that is, a "one excavation unit — one cultural unit" premise. Now, I fully expected that he might not recognize this premise. In fact, I actually said that I believe it to be "perhaps unconscious." Thus, it is no surprise that it does not appear in his original monograph explicitly stated in so many words. But it also follows that any refutation of it must lie, not in demonstrating the absence of such an explicit statement or in noting the presence of other stated premises, but rather in careful and penetrating analysis of his theoretical scheme, both explicit and implicit, and of his procedures in handling empirical data and the inferences derived.

In my study for reviewing his monograph, I did this. I do not believe that MacNeish had done it before writing his *Rejoinder*. In fact, he says that he will "repeat," "reiterate" his premises and bases for establishing phases, as if by doing so his case would stand proved. But I said in my review, and I say here, that only by going "deeper into his procedures and his premises" can we (and this includes MacNeish himself) understand his theoretical position. And I believe even more strongly today that this is the only way MacNeish can prove himself right and me wrong. Restatement of explicit premises does not establish or refute unconscious premises.

Be this as it may, the most significant thing about his *Rejoinder* is the amount and character of new data introduced and the startling differences between these, substantively and in implication, from those that he gave in the original publication which I reviewed. Aside from the questionable propriety of belaboring me for failing to analyze data not in the publication under review, the issue which I shall engage here concerns these differences and their significance for an understanding of MacNeish's theoretical position and his use of archaeological data.

In the *Rejoinder*, he says:

> I shall briefly *repeat* what my premises actually were. . . . As indicated on page 9 of the Tamaulipas work, the major premise is that a distinctive congery [sic] composed of an adequate sample of artifacts and traits that occurs at one or more (pure) components, each of which represents an occupation, shall be the basis for establishing a phase [italics mine].

But these words do not appear on page 9, *or on any other page*, of the original monograph! Therefore, he is not "repeating," as he says he is doing. Referring to page 9 of the Tamaulipas work, we find that he actually said:

> The complexes, congeries, or clusters [of artifact types], belonging to these various levels or layers of excavated sites, are here called components, while complexes of types from unexcavated sites (surface collections) are merely called site collections. From the standpoint of description and organization, it was necessary to classify these components with identical or very similar congeries of types in convenient units. Such a unit I have called a "phase." . . . I have assumed that a phase represents the preserved material remains of a single group of people at what, for heuristic purposes, is considered a moment in time. . . .

That is all there is on the establishment of phases: nothing about "distinctive congeries," or "adequate sample," or "pure component." Furthermore, he says that he "assumes" the phase represents a single people, not that a (single) occupation *constitutes* one criterion for a phase.

Thus, it is hardly a wonder that, as MacNeish says, I "did not discern this major premise." It was not mentioned in the report I was reviewing and, left to my own devices, I certainly did not get even an inkling of it while studying the monograph itself, because everything he said there led me to infer quite another premise, namely, the "one congeries–one phase" premise which I stated in my review. In that place, I gave considerable documentation for my contention, and I see no advantage in repeating or amplifying it here, particularly since MacNeish has not rebutted any of that documentation in his *Rejoinder*. But let us continue with the matter of establishing phases.

MacNeish says in his *Rejoinder*:

> Now let me *reiterate* briefly how and on what basis the phases were established [italics mine].

He then proceeds to give a long exposition of a sequence of analysis by which his phases allegedly were constructed. This exposition is interesting, informative, and valuable. But to my knowledge, *this is the first time it has appeared in print!* Certainly it is not to be found in the Tamaulipas report — if it had been there, my review would have been quite different. On page 152 of that

report, there is a presentation of his sequence of analysis, in what I take to be chronological order as evidenced by such phrases as "then," "from these studies," "at this stage of our analysis." The only trouble is that this account does not jibe with that which he gives in his *Rejoinder*. In the latter publication, MacNeish says that he is appalled because I wrote the review I did. I can tell him now that I wrote the review I did because I was reviewing his original monograph, not his *Rejoinder*.

Yet he uses the word *reiterate*. What can this mean? Webster says the word means "to repeat; to say or do over again or repeatedly." Is MacNeish trying to give the readers of his *Rejoinder* the impression that he is repeating statements which I failed to catch in his original report? Surely he could not be doing this, because this would be untrue: he is not repeating. Nor can he be talking to those "careful and understanding" readers of the original report, whom he asks to stand by while he refutes me, because they would certainly know that he is not repeating. For whom, then, is he writing? Perhaps he is writing for himself. Perhaps he is trying to convince himself that his Tamaulipas work was indeed based on the more solid and acceptable premises of his *Rejoinder*, not on those of his original report. This is just a suggestion.

Now let us look at another aspect of his statements on the phases. No less than eight times in the course of the relatively short *Rejoinder*, he uses the phrase "pure component" to describe the nature of those particular artifactual congeries or clusters to which he says he gives the name *phase*. In one place he says:

> [Taylor] made this mistake [of not recognizing the major premise which MacNeish claims to have used] in spite of the fact that I used the word *phase* as opposed to complex, *pure* components in distinction to possible, probable, and doubtful components or site collections; and I made a point of *not recognizing* certain phases until pure components occurred . . . [italics his].

But in the original monograph, the phrase *pure component* is never used and, as far as I can see, even the concept, however worded, is not used except in two very specific and non-theoretical descriptions where he refers to a "pure" site (p. 7) and to "relatively pure examples of the Lerma Phase" (p. 30). It is very obvious, therefore, that the concept of "pure component" as a criterion of phase is a product of MacNeish's later years. While, in the Tamaulipas report, it is not even mentioned in the sections dedicated to theory and method (pp. 5–10) or even in the discussion of the phases themselves (pp. 152–65), in the *Rejoinder* it plays a prominent, even dominant, part in his (new) theoretical scheme. I am very sorry he did not define it and use it in the monograph which I reviewed, because I am sure that it would have been basic to my understanding of his theoretical point of view. However, since he has never defined it, even in the *Rejoinder*, perhaps it is not a clear concept in his mind and had better be left for some still later time for definitive treatment.

Furthermore, there is only one place in the original monograph (p. 9) where he explicitly distinguishes between the concept of phase and that of complex:

> A second classificatory term is "complex" which I apply to a congeries or cluster of types that occurs in a number of site collections (non-excavated sites). . . . In reality my complexes are tentative phases.

Nothing is said here about "pure components" versus "impure" complexes, and the term *complex* is specifically restricted to site collections, that is, congeries from unexcavated sites. The fact that MacNeish does not conform to his own definitions, as in his use of the word *complex* for components of excavated sites (p. 152) and for artifact assemblages in general in his section entitled "Summary of the Artifact Complexes" (p. 152), does not alter the fact that according to his own theoretical dictamen the concept *complex* applies only to groups of artifact types from unexcavated sites. It is perhaps significant, and in support of the major premise which I suggested in my review, that MacNeish, when writing in a strictly theoretical vein, makes no provision for complexes (tentative phases) in excavated sites. If my analysis of his premises is correct, his theoretical reasoning might go something like this: the physical grouping of artifacts (the component) is given by the mechanics of digging and the only cultural decisions that have to be made concern the further grouping of components into phases; in non-excavated sites, on the other hand, the initial component is not given physically, except in the broadest and hence virtually meaningless sense, thus cultural decisions have to be made on two levels, both component and phase; this creates more uncertainty and "tentativeness" and brings the need for a different term (*complex*) to designate such congeries. If this is correct, it supports my contention that the "one excavation unit–one cultural unit" premise is central to MacNeish's theoretical scheme. It is further significant that, as one might expect, he does not (cannot?) adhere strictly to this distinction.

To bring up another point, I note that in his *Rejoinder*, he says:

> This will further illustrate that . . . the master sequence [of phases] definitely was not "based largely on the findings in Diablo Cave" [as Taylor claimed in his review].

This came as a definite surprise to me, because in his original report he had said:

> In the analysis, the artifacts from the six layers from Tm c 81 [Diablo Cave] were *studied first*. Five sequential complexes of artifacts, or components of phases, were noted: from early to late they were tentatively named Diablo, Lerma, Nogales, Eslabones, and Los Angeles [p. 152; italics mine].

Since there were but nine cultural units defined from this region and since he specifically says that five of them had been *studied first and noted* in the analysis of artifacts from Diablo Cave, I thought myself on pretty safe ground in making the statement I did. What he said about his ceramic analysis led me to the same conclusion, although the pottery from Diablo Cave was apparently in the lot that was studied after the first two sites, Tm c 86 and Tm r 79, had been analyzed. Nevertheless, the analysis of Diablo Cave was certainly among the first in ceramics and the very first in other artifacts.

But then the thought struck me that perhaps MacNeish's phases were not established on the basis of arti-

factual or of ceramic analysis, but on some other information and *before* these analyses were undertaken. I began to search the Tamaulipas report for evidence which might throw light on this possibility. Some of what I found I published as documentation in my review, but it was not until the *Rejoinder* appeared that there was explicit evidence from his own words.

In trying to refute my contention (that his sequence of phases had been "based largely on the findings in Diablo Cave"), he said in his *Rejoinder*:

> . . . three phases — originally called periods of the Pueblito culture — were established in 1946, before I had ever heard of Diablo Cave.

In the first place, if only three had been established before hearing of the site, my contention would still be correct because he says that five had been noted and tentatively named from the analysis of Diablo Cave. Thus the sequence would still be "largely" from Diablo Cave.

However, let us look at MacNeish's research timetable for a moment. He says that his first work in the Sierra de Tamaulipas began in April, 1946, and that it was primarily one of reconnaissance (p. 6). By May 26th, of that same year, the first field season was over, and he was able to study other collections of Tamaulipecan material. He says (p. 7):

> Thus, by May of 1946 archaeological materials were available from 171 sites in Tamaulipas. To establish, in a preliminary way, what artifact types existed and what the artifact complexes were, and to determine which sites were most suitable for excavation, an analysis was *then* made. . . . This analysis, which started in 1946, continued in 1947. . . . Thus in November of 1948, excavations began [italics mine].

Somewhat later in the same publication (p. 21), he says:

> I first visited the rock shelter [Diablo Cave] in the spring of 1946 while making preliminary survey of the northern Sierra de Tamaulipas. At that time Pedro Lerma (guide), Roberto Pavon (assistant) and I sank a test pit. . . .

These facts and statements when put together yield the following timetable:

1. field survey of Sierra de Tamaulipas begins in April, 1946
2. three phases established before Diablo Cave "heard of"
3. Diablo Cave visited and tested before end of field survey
4. field survey ends May 26th, 1946, after 13 sites visited and tested (his first published report, MacNeish 1947, says only 8)
5. study of other collections of Tamaulipas material after survey ends
6. preliminary analysis to establish artifact types and complexes
7. excavations begin in November, 1948

I find it interesting that by Step 2 in the above timetable, even before "preliminary analysis" had been made, MacNeish had been able to establish three phases — not complexes, but *phases*. I believe that this illustrates clearly that his statement about his premises and criteria for the establishment of phases, as quoted above from the *Rejoinder*, is just not true. In this instance, I question very seriously that by the time of Step 2 of his research he could have been able to determine that his congeries were "distinctive" or what really constituted a "pure" component. As for the criterion of "adequate sample" for the determination of phases, I offer examples of his statements on the two sites upon which rests the determination of the Eslabones phase (one of the "first three" established):

> [In Tm r 86] a trench was put on one of the small plazas, and the top soil was removed from two house platforms. These gave us *only a small sample* of materials; *more would be very desirable* [p. 41; italics mine]. [In Tm r 6] the refuse was not deep, and *the materials were sparse* [p. 52; italics mine].

Even more significant, perhaps, is the change in evaluation which came over MacNeish when he wrote his *Rejoinder*, in which he says:

> The Eslabones phase was established on the basis of *abundant materials* . . . found first in Level 3 (a house floor) at Tm r 86 and duplicated in two test pits in house-platform floors at Tm r 6 [italics mine].

Such differences between the two publications are not uncommon, but the really significant thing is, I believe, that the statements in the *Rejoinder* support the theoretical position which MacNeish assumes in that publication, while the statements found in the original report support the more general, the less precise and demanding criteria set forth there. I refer my present readers to the use of the qualificatory words such as "tentative," "probable," and "possible" when MacNeish refers to phase assignments in the *Rejoinder* — and to the consistent lack of same in the assignments of his original monograph. For example, in the former he says:

> A primary corollary to this [his "major premise," as quoted in the first quotation above] is that congeries of artifacts which come from excavation units may *tentatively* and with definite qualifications be consigned to one of the established phases on the basis of limited similarities. A second corollary is that in cases where there are no established phases . . . components or site collections may be tentatively classified as belonging to complexes [italics his].

But nowhere in his original monograph, and I repeat NOWHERE, even during his discussion of the cultural components of his excavated sites (pp. 21–45) and in his "Summary of the Artifact Complexes" (pp. 152–65), does he use in his phase assignments the word *tentative* or *tentatively* or their conceptual equivalents. I find only one place in the entire monograph where *tentatively* is used in this manner: on page 105 in his description of pottery.

Only in his accounts of the "surveyed sites" (pp. 45–57) does he use qualifying words and phrases at all, and even with these one cannot be sure that there will be concordance between what he says there and what he says in his *Rejoinder*. For examples, I refer the interested reader to sites Tm c 322 and TM r 323 which, in the latter publications, are "considered *probable* components [italics his]" and which "were given this less definite status because the materials came from a context that did *not indicate* [italics mine] a definite, single occupation." Compare the above with the following from the original report:

> [the sherd types] *indicate* that [Tm c 322] belongs to the La Salta Phase [p. 54; italics mine].
> [the combination of pottery types] *indicated* that Tm r 323 belongs to the La Salta Phase [p. 54; italics mine].

What happened to the "probable," "less definite" status? How is it that in his original publication the materials "indicate," while in his later publication the same mate-

rials do "not indicate"? If these were isolated instances, they might be attributed to a simple misstatement. But when there are so many of them and when the positive assignments of the original report are so consistently followed by qualified assignments of the same components in the *Rejoinder*, happenstance appears to be ruled out.

From all the above, it seems very clear to me that MacNeish did indeed set up phases, at least three of them and probably more, on the basis of excavation units — before detailed and thorough cultural anlysis and comparison had been made. It is also clear that he identified artifactual congeries determined by excavation unit, that is, level or layer, as cultural components which he grouped with identical or very similar congeries into phases. Of course, the gimmick here lies in the words *identical or very similar*. Since definitions of such terms are largely a matter of opinion and were not defined by MacNeish and since space here is limited and my review contained statements as to my own opinion on this subject, I shall not elaborate upon this point. But using his own statement from the original publication (p. 152 and quoted above), I still maintain that his sequence of phases is *largely* (that is, five units out of nine) based upon Diablo Cave as I said in my review that it was. Finally, it is very evident that MacNeish has changed both his theoretical position and his statements concerning many of the facts between the time he wrote the original monograph and the time he wrote the *Rejoinder*.

I do not see much use in discussing the rest of MacNeish's points. They are largely matters of opinion or interpretation and would require an unjustifiable amount of space to discuss. However, two things I do wish to acknowledge. First, if, as he says, I did not answer a plea for information from him, or from any colleague, I am truly sorry. Frankly, I do not remember getting the two letters he says he wrote, and a check in my files fails to produce them. However, I apologize for my share in this particular fiasco. In the second place, I should like to point out that the cultural groupings which I suggested as possibly being more realistic and significant were indeed taken directly from his monograph. I intended to make no claim of originality, but on reading over what I wrote, I can see how this interpretation might be made. I apologize for this also and assure MacNeish that I did not mean to plagiarize, but rather to support, something which he had so plainly proposed.

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GUESS DATING FOR JARMO

Robert J. Braidwood

Abstract

The original guess dates for Jarmo were about 6000 B.C. (and thus close to the recent Washington and Heidelberg radiocarbon dates of 6750 B.C.) rather than about 4750 B.C. (the date derived from Libby's original radiocarbon determinations) as suggested in the papers on obsidian dating in *American Antiquity*, Volume 25, Number 1.

I SHOULD LIKE to correct one impression which the very interesting articles by Friedman and Smith (1960) and Evans and Meggers (1960) might leave. As Evans and Meggers suggest, the Jarmo dating situation is "already confused" quite enough. Both articles (pp. 515, 537) refer to Braidwood's "original" or "early guess dates" as if these were about 4750 B.C. (6700 B.P.). But this was not our guess dating for Jarmo in the usually accepted sense. The 4750 B.C. depended on Libby's early radiocarbon determinations: C–113 (6707 ± 320 B.P.), C–742 (6606 ± 330 B.P.), and C–743 (6695 ± 360 B.P.). To the best of our recollection, our single published indication of a pre-radiocarbon guess dating for Jarmo was "c. 6000 B.C." (Braidwood and Braidwood 1950: 195, note 1), and the general order of my own pre-radiocarbon guessing shows clearly in my first edition of *Prehistoric Men* (1948: 89), the manuscript for which was prepared just before Jarmo was first dug or any radiocarbon determinations for the Near East were available. Actually, our early guesses were thus quite close to the Washington and Heidelberg cluster of determinations, which we now prefer, at about 6750 B.C. (Braidwood 1959).

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August, 1960

THE HOHOKAM CANALS AT PUEBLO GRANDE, ARIZONA *

RICHARD B. WOODBURY

ABSTRACT

A cross section of the surviving traces of two large prehistoric canals near Pueblo Grande, Phoenix, shows one to have originally been V-shaped in profile, about 6 m. wide and 4 m. deep, and the other U-shaped in profile, about 10 m. wide and 3 m. deep. Both were dug into coarse gravel and the broader (north) canal had been lined with brown clay subsequent to its construction and initial period of use. There is a possibility that the V-shaped South Canal was built first and perhaps abandoned when the North Canal was built. Both canals show evidence of repeated filling and clearing out, either by natural erosion due to a periodically swifter current or by the efforts of the Indians using the canals. Sherds under the banks and in the canals were too few for conclusive dating of construction and use, but suggest that this took place during the Soho phase of the Hohokam Classic period, that is, during the late 12th and the 13th centuries. Hohokam canals much older than this are known, and the occupation of nearby Pueblo Grande began earlier and lasted later than the Soho phase.

INTEREST in the surviving, visible remains of ancient irrigation canals in southern Arizona and northern Sonora has been long and intense, going back at least to Manje's careful notes on the canal at Casa Grande ruin in 1697 (Karns 1954: 86), and including such observant travelers as Rusling (1877: 394–6) and the records of several local residents, particularly Patrick (1903) and Turney (1929). Nevertheless, the body of information available has consisted largely of unsystematic comments on the surface appearance of these canal remnants, and the investigation of Hohokam irrigation by archaeological techniques has proceeded very slowly. The work that Cushing directed at Los Muertos was reported by Hodge (1893) and supplemented by Haury's monograph (1945) which also summarized the available information on the subject. The only thorough excavation of a Hohokam canal that has been reported is the cross sectioning at Snaketown in 1935 (Haury 1937) which provided clear association between the stages of construction and use of the canal and the ceramic sequence being worked out at the site. On this basis it was possible to assign the beginning of the Snaketown canal to about A.D. 800 and suggest that it was in use for about 500 years. Careful mapping of the entire surviving Hohokam canal system, making use of aerial photographs, was begun by the Smithsonian Institution in 1930 (Judd 1931) but never completed due to the pressure of other activities and the lack of funds.

The interdisciplinary program in the utilization of arid lands which is being carried on at the University of Arizona with financial support from the Rockefeller Foundation of New York has made it possible to examine several surviving Hohokam canals, including (during October and November, 1959) the well-known pair of canals in the Park of Four Waters, Phoenix. This city park, of about 10 acres extent, is located just across the modern Grand Canal and the Southern Pacific tracks from the Pueblo Grande Museum, in the stockyards area of eastern Phoenix. Although the location is far from scenic, surrounded as it is with industrial activities, it has been protected from the encroachments that have destroyed all trace of most prehistoric canals in the Salt River Valley.

Prior to this recent excavation, which is reported in preliminary form here, the canals at Pueblo Grande were marked by two pairs of conspicuous parallel ridges, the remains of the banks which several centuries of erosion had not yet leveled. The actual channels were filled to about the level of the surrounding land, although the height of the banks gave the illusion of two deep channels. Both canals trend to the west and northwest, gradually swinging away from the Salt River which lies nearby on the south. At their eastern ends they are so close together that their adjacent banks merged into a single bank. This has been thought in the past to indicate that either (a) they forked just to the east from a common parent canal, now entirely destroyed by recent floods of the Salt, or (b) they both headed here, at a time when the Salt flowed closer to the spot than it does now. As will be shown, both of these beliefs are almost certainly wrong. The canals, at the point investigated, run along a low terrace of the river, only a couple of meters above the present channel, which is here nearly a half mile wide but flowing only in rare floods.

Excavation of a cross section of these canals was greatly aided by the generous loan of a Gradall, with its two operators, by the Salt River Valley Water Users Association. The 60-m. trench with sloping sides which the Gradall dug to a depth of two to three meters was further deepened by hand where it crossed the filled channels of the two canals, and one wall was cleaned to permit observation of the stratigraphy.

One of the most impressive revelations of this trench was the size of the original canals, about 10 and 6 m. wide at the former ground level, and about 26 and 18 m. wide from crest to crest of the banks, as shown in Figure 1. Also, the fact that subsequent filling of the channels had raised the level between the banks to slightly higher than the original ground level is of interest, since it vitiates inferences that have been made in the past (see, for example, Turney 1929: 47) concerning the relationship of river channel elevation and canal elevation. Such inferences have been based only on observations of present surface indication, which this cross section shows to be inadequate for estimating original depth (or profile).

The North and South canals proved to be quite different in profile (Fig. 1), the North Canal being flat-bottomed with the sides sloping at about 35°, the South Canal V-shaped in profile with the lower part of the sides sloping at 50° to 60°. Nevertheless, they contained rather similar fills, ranging from coarse sand through fine sand to silt, much of it laminated and indicating successive phases of deposition, with either periodic intentional cleaning or natural removal of the deposits. Both canals

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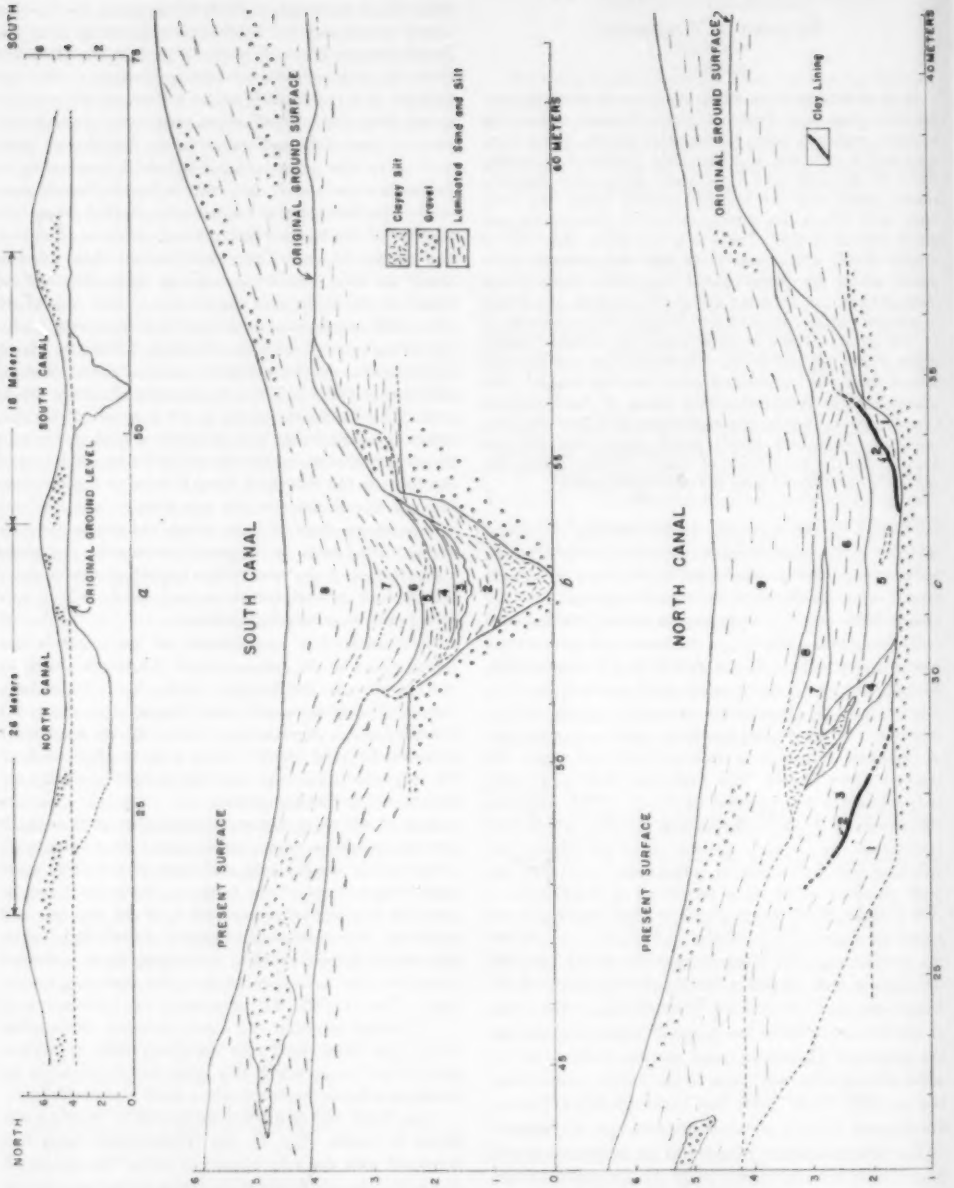

Fig. 1 [Woodbury]. Cross sections of canals at Pueblo Grande. *a*, the entire trench, showing relation of canals and banks; *b*, detail of the South Canal; *c*, detail of North Canal.

were dug through an otherwise undisturbed layer of fine-grained, river-laid sand ranging in thickness from 1.5 to 2.0 m., and both were dug into underlying coarse gravel, a most unpromising material for holding the water that the canals were constructed to carry. There is, of course, a possibility that the water table was high enough in ancient times for the canal bottom to have penetrated it, and thus considerably reduced the loss of water in transit. However, in the North Canal, the remains of a substantial clay lining were found resting on the lowest of the sandy fills in the channel. The lining consists of a compact, homogeneous layer of chocolate brown clay, from 5 to 9 cm. thick, with a cracked and uneven upper surface as though exposed to the sun. Careful examination revealed no lamination or horizontal structure within the clay, such as would indicate that it was naturally deposited in standing water. Furthermore, although the layer of clay was not traceable across the bottom of the canal, where it had probably eroded away, it was well preserved for a considerable distance up the sides; if this were the remnant of a water-laid layer it would have originally been over a meter thick, a wholly unreasonable deposit in such circumstances. Instead, the evidence points clearly to its having been laid by hand, with clay brought from a source not yet identified but possibly within a few miles. The total extent of this clay layer can only be guessed, but its presence was verified in test pits 40 and 145 m. to the west. With an observable width of at least 8 m., and assuming a minimum thickness of 5 cm., such a lining would have needed at least four-tenths of a cubic meter of clay for every linear meter of canal. Only a very critical need could have justified bringing in such a quantity of material. The need was undoubtedly for a canal bottom that would lose less of its water in transit, as the channel is here dug into coarse material into which water would percolate easily. Many modern irrigation canals are, of course, lined with concrete for the same purpose, the cost being more than offset by the saving in water. No other Hohokam canal has been found with an identifiable lining, although some early and unsubstantiated reports mention the use of adobe or clay for this purpose. It is doubtful if this was ever a common practice but in this instance there seems little doubt that at least part of a large canal was carefully lined to render it practically watertight, even though the cost in labor must have been enormous. It should be noted that the canal saw use for at least a short time prior to the addition of the lining, as shown by the deposit underlying it (number 1 in the cross section).

The canal banks are made up, as would be expected, initially of the material excavated from the channels during construction. All three banks contain, at the base, unstratified sandy material identical with the undisturbed material below it except for the latter's laminated condition. The presence of a few sherds at the contact between the stratified and the homogeneous material helped in determining the position of the original ground level. As the construction of the canals progressed and the diggers encountered coarse gravel, this was piled on the banks above the finer, sandy level. This gravel, being the last material dug out of the channels, should have formed the tops of the banks, and probably did at first. But the banks were further augmented by fine material, silt and sand, cleared from the channels, so that today the banks still stand 2.0 to 3.0 m. high even after enough material has been washed down from them to completely refill the canals. This should, then, be a rough indication of the quantity of sand and silt dredged from the channels during the years that they were kept in use.

It was hoped that clear evidence would be found in the central bank, shared by both canals, for the priority of one canal or the other. This proved difficult to determine, as no clear line could be found separating the material piled onto the bank from the North and South canals. Nevertheless, the position of the gravelly zones in this central bank suggests that the larger zone, extending from 44 to 48 m. in the profile, comes from the South Canal, and is overlain by finer material at its north end as a result of the subsequent excavation of the North Canal. The position of two smaller gravelly zones high in the north side of the central bank also suggests that the North Canal was dug after the South Canal had been in use long enough to require considerable clearing. Therefore, it is probable but not certain that the South Canal is the older.

The difference in elevation between the bottoms of the canals is of considerable interest. If the two canals were branches of a parent canal (now destroyed by the river), they would have to be approximately the same elevation. Therefore, this widely-held belief must be discarded. The bottom of the South Canal is about 1.5 m. below the bottom of the North Canal, and is about the same elevation as the dry bed of the Salt immediately to the south. It is possible, therefore, that the South Canal headed only a short distance to the east; the North Canal would have had to head some little distance further upstream to gain its higher elevation. It is much less probable that both canals headed nearby to the east, and that lowering of the river channel by erosion resulted in abandonment of the higher, northern channel and digging of the new channel to a greater depth. Much less labor would have been required for the deepening of the already existing channel.

The successive fills of the two canals could not be correlated with each other, and there is no way to determine at what point in the history of the South Canal the North Canal came into use — if, as we suspect, they were used in this sequence; their spans of use may, of course, not have overlapped at all. The fills, as observed in cross section, are separated by fairly clearly defined discontinuities. However, the material of one fill is very similar to another, the variation being in fineness of particles and in changes in the thickness and dip of the bedding planes that record each layer's manner of deposition. A detail of excavation technique is of interest in connection with these fills; observation of details was made easier by the passage of a few days because the loss of color difference due to drying was less important than the clear and delicate etching that was produced by the strong winds that blew nearly every day. The relief that was developed between the more compact and less compact laminae

could be only partly achieved by gentle jabbing with a fine-bristled paint brush, but this substitute for a few days' wind action was helpful in making possible immediate interpretation of exposed portions of the profile.

The fill of both channels shows one characteristic shared with modern irrigation channels and permanent streams. When the rate of flow is increased by an increase in the volume of water, previously deposited materials are removed, but mainly from the bottom of the channel and to a lesser extent from the sides. This can be easily observed in the cross section of the North Canal; the deposits labeled 1, 3, and 4 are entirely absent at the center of the canal but remain at one or both sides. In the South Canal, the oldest fill, No. 1, appears to have been two or three times as thick as the remaining portion at the center of channel, with all but a small portion against the south side cut away prior to deposition of fill 2.

Dating the construction and use of the canals has proved difficult. Their proximity to Pueblo Grande would suggest use during its occupation, which probably extended from the 12th century to the end of the 14th, with a large part of its construction during the Soho phase, approximately 1150 or 1200 to 1300 (Hayden 1957: 184–91). However, examination of the few sherds found in and under the canal banks and in the canal fills shows no evidence of construction before the Soho phase or of use after it. The small number of sherds makes such a conclusion somewhat less than final, and the possibility cannot be eliminated of a much earlier canal having been completely cleaned out or totally re-excavated and enlarged, thus removing evidence of its original date.

The total extent of these canals was recorded by both Patrick (1903) and Turney (1929), Turney probably depending heavily on Patrick's much earlier first-hand observations. The North Canal is shown as extending for about 9 miles, the South Canal about seven. Both are shown heading about a half mile east of the Park of Four Waters. There is an apparently reliable local recollection, however, that before the end of the last century one of these canals could be traced another two miles eastward, to a point opposite Tempe Butte (O. S. Halseth, personal communication). It may never be possible to establish the original length of these canals precisely, but the general order of magnitude suggested here is undoubtedly correct. Both canals are comparable in length to some of the modern canals in use today. It might be expected that canals of such size, involving substantial and probably protracted labor in their construction, would have been used for more than the century or so suggested by the ceramic evidence. On the other hand, many causes may have been responsible for their abandonment after a relatively brief span of service—excessive silting, waterlogging of the fields they served, or changes in the river.

It is too early in the current study of prehistoric land- and water-use in the Southwest to attempt answers to the many questions posed by Hohokam irrigation. Its origins, its extent, and the reasons for its decline need much further study, and the social and economic implications of this extensive system of large canals are not yet understood. As this study progresses it is hoped that all of these aspects of Hohokam irrigation will become better known. A more detailed report on the canals at the Park of Four Waters, and reports on the other investigations now in progress will be presented in the future.

Acknowledgments. This work was made possible by a grant of the Rockefeller Foundation of New York to the University of Arizona and was aided by the cooperation of O. S. Halseth and D. H. Hiser of the Pueblo Grande Museum, Phoenix; the Salt River Valley Water Users Association; the Tovrea Stockyards; and E. W. Haury and W. W. Wasley of the Arizona State Museum, Tucson. The cross section (Fig. 1) was drawn from the field records by Robert F. Burgh, Tucson.

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WATERFALL CAVE, SOUTHERN CHIHUAHUA, MEXICO

Robert Ascher and Francis J. Clune, Jr.

Abstract

This cave in the Sierra Madre Occidental was excavated to obtain information from a little-known region which might help clarify problems of Mexican-Southwestern contacts. The excavation produced ten burials with associated mats and blankets, only a few artifacts, and both cultivated and gathered plant remains. Stylistic elements of Mogollon and Casas Grandes pottery and the cultivated plants suggest a beginning date of A.D. 1000;

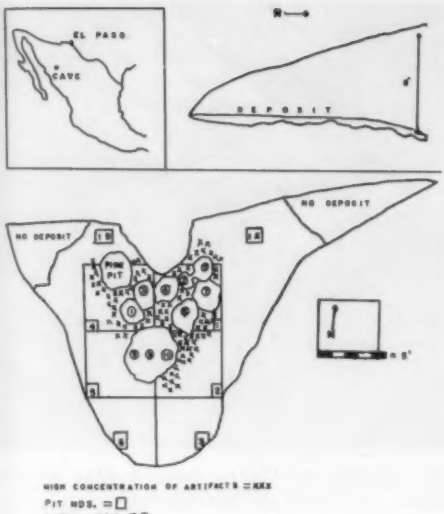

FIG. 1 [Ascher and Clune]. Map of Waterfall Cave showing excavation grid, position of burials, and area of high concentration of artifacts.

the lack of European artifacts, a terminal date of 1600. The death complex is interpreted by analogy with modern Tarahumara practices. The use of the cave is described in terms of a series of events and episodal analysis is presented as a way of operationalizing the conjunctive approach.

WATERFALL CAVE, in the Sierra Madre Occidental, southern Chihuahua, was excavated in the summer of 1958. The excavation was focused on two problems: (1) investigation of a single site in a region (Willey and Phillips 1959: 19) about which no controlled archaeological field research has been reported with the exception of Zingg (1940); and (2) collection of data which might aid in testing the hypothesis that the Sierra Madre Occidental served as a corridor for prehistoric contacts between Mexico and the classical Southwest (Lister and Howard 1955: 129; Lister 1958: 118–9). Waterfall Cave is approximately 160 miles east of Guaymas, 135 miles west of Chihuahua City and 300 miles southwest of El Paso. It is at an elevation of 4500 feet, at the upper fringe of the *templada* climatic belt. Rainfall ranges from 700 to 800 mm. per year. The *barranca* terrain is dominated by slopes of more than 25° from the horizontal. The area is presently inhabited by the Tarahumara Indians and Mexicans.

Maximum dimensions of the cave are 37 feet wide and 17½ feet deep. The cave base is irregular; small flakes of bentonite, biotite mica, and particles of decomposed plagioclase feldspar indicate volcanic origin. The cave deposit consisted of gray, ashy dust mixed with vegetable materials at a volume ratio of approximately 4 to 1. Due to the irregularity of the base, the deposit depth varied from 1 to 15 inches, with an average depth of less than 6 inches. A modified 5-foot grid system and two "wings" (Fig. 1) were used in excavating the cave. The entire deposit was passed through a ¼-inch mesh screen. Because of shallowness, irregularity, and apparent lack of vertical stratification, each pit was excavated to the cave base and recovered materials were recorded according to pits and horizontal positions within pits.

Pottery. R. H. Lister identified the plain and incised sherds as Alma Plain (Haury 1936: 32) and Alma Incised (Haury 1936: 40). The painted sherds had bands of black, red, and silver on light brown backgrounds. The painted sherds were identified by C. C. Di Peso as comparable with Ramos Polychrome in the Casas Grandes series. They differ from Ramos Polychrome, however, in the use of black specular iron for banding. Black specular iron is found on Nogales Polychrome and Trincheras Purple-on-red. The latter types are comparable with the painted sherds from Waterfall Cave only with respect to the single decorative mode of specular paint.

Textiles include eight mats and 21 blanket fragments, all recovered in association with burials. Additional textiles are three cordage fragments, one feather-wrapped, one a leader on a fishhook; a string girdle and three cordage fragments in association with Burial 8. The textile material is analyzed in detail in the accompanying paper by Clune (1960).

Vegetable material consists of both cultivated and gathered plants. The cultivated plants — corn, beans, squash, and bottle gourds — are discussed in the accompanying paper by Cutler (1960). Gathered material includes yucca and cactus.

Fecal material. Gross analysis of three fragments of human feces showed a high percentage of fibrous material, small seeds, and grains of minerals.

Lithic material. Three chipped stone artifacts, three unmodified cobbles, and 30 flint fragments were recovered (Fig. 2, Table 1). The artifacts were made of a light grayish-pink flint with darker inclusions up to 1 mm. in diameter. The unmodified cobbles are basalt.

Bones. Twenty-eight unmodified bones, eight of which are tortoise, were recovered. The remaining 20 fragments are too small to be identified, but the size of the fragments suggest an animal or animals no larger than a rabbit.

Burials. Ten burials were found (Figs. 1, 3, Table 2); Numbers 1–7 had been disturbed previous to the excavation. Burials 1 and 2 may have been interred in close association. The best preserved burials, Numbers 8–10, were definitely associated. Two large corn cobs, one in the arms of the child and one between the skulls of the female and child, and numerous acorns were found in place in the Burial 8–10 group. The burial complex contained the following elements: individual and multiple interments, bodies tightly flexed and lying on the side, skulls generally facing the entrance of the cave, bodies blanket wrapped, mats wrapped around blanketed bodies, rocks on top of mats and cave deposit on top of mats.

Features. A fire pit (Fig. 1) was excavated in close association with the burials. The fired area consisted of a heavy concentration of ash and numerous small charcoal fragments.

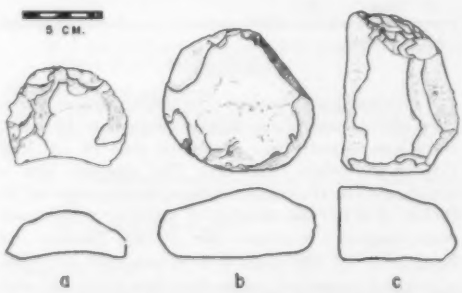

FIG. 2 [Ascher and Clune]. Chipped stone artifacts from Waterfall Cave.

Table 1. Artifactual and Non-Artifactual Material

Item	Frequency	Comments
Corn cobs	40	See Cutler, 1960
Corn ear	1	
Corn husks	5	
Bean bean	1	
Bean pods	5	
Squash	5	
Bottle gourd	1	
Yucca seed pods	3	
Yucca cud	1	
Yucca bulbs	4	
Yucca leaf-base	5	
Cactus-spine fishhook	1	See Clune 1960, Fig. 1 *a*.
Palm frond	1	*Washingtonia* sp. (?)
Pods	3	*Bombax palmeri*
Wood	10	unmodified
Cane	7	*Arundo donax* unmodified
Cuds	7	unidentified fibers
Human fecal material	3	high fiber content, some rock fragments over ⅛" in diameter
Chipped stone	4	Fig. 2
Ground stone	3	one metate, two manos, unmodified cobbles
Unmodified		
Tortoise bones	8	
Mammal bones	20	
Plainware sherds	128	Alma Plain
Incised sherds	8	Alma Incised
Polychrome sherds	5	See text for discussion.
Baked clay	1	with impressions of grass or corn husks

Table 2. Burials *

Burial Number	Sex	Age	Comments
1	Male	20–35	Slight fronto-occipital deformation.
2	Female	35–50	Two abscessed teeth; second premolar, upper right, lower right; molars on lower left mandible missing with resorbtion present. Fronto-occipital deformation.
3	Male (?)	20–35	Extreme occipital deformation, the right side more than the left. Some caries in molars.
4	Male	35–50	Occipital deformation present. Two head wounds both healed, one almost along the sagittal suture, the other over left orbit.
5	Child	6–10	
6	Female (?)	16–20	Three abscessed teeth; extreme shoveling of incisors.
7	Female	20–35	
8	Child	6–10	Buried together.
9	Female	20–35	
10	Male	20–35	

* All left at site.

Discussion

Temporal-Spatial Analysis. The combination at Waterfall Cave of some of the stylistic elements of Mogollon and Casas Grandes sets a minimal date of A.D. 1000 (Martin and others 1952: 483). The minimum date is corroborated by the cultivated plant analysis reported by Cutler (1960). The absence of artifacts of European origin suggests a maximum date of 1600 (Bennett and Zingg 1935: 7). The limits in both frequency and range of cultural complexes, other than that associated with death, prohibits the use of such materials as time-space markers. Individual elements of the burial complex, such as the flexed position, and wrapping occur 100 miles to the north in Cave Valley (Lister 1948: 20, 93) but the complex, with variation, is reported only in the southern Chihuahua Sierra region (Zingg 1940). Lack of a stratified deposit further restricts using the evidence in testing the hypothesis that the Sierra served as a corridor for prehistoric contacts between Mexico and the classical Southwest. Nevertheless, the range in sub-species of maize, some of which may have developed to the north, and others of which almost certainly evolved to the south, coupled with individual elements of the Mogollon culture pattern (Wheat 1955: 160–5), suggests that the results of further excavations may support the hypothesis and define the directions, contents, time, and intensity of contacts.

Fig. 3 [Ascher and Clune]. Burials 8–10 at Waterfall Cave, partially excavated.

Episodal Analysis. The conjunctive interpretation of the Waterfall Cave evidence is largely limited to the death complex of the culture pattern. The following evidence suggests the hypothesis that the cave served primarily as a burial place and secondarily for habitation: (1) the site deposit is shallow; (2) few artifacts, considering the excellent conditions for preservation, were recovered; (3) the frequency of non-artifactual material and the volume ratio of dirt to vegetable matter is lower than might be expected from a dry cave inhabited over a period of time; (4) the artifacts and non-artifactual materials are concentrated in the burial area (Fig. 1); (5) moving about in the cave would be difficult once a few burials had been placed there. The chipping waste, fecal material, stone artifacts, and corn cobs without kernels, suggest that the cave was utilized as a temporary camp. Judging from the low frequency of material in any single category it was probably not inhabited for more than one or two days.

It is often difficult to reconstruct episodes on the basis of archaeological data. The episode is here defined as a

series of events which defines the temporal and contextual limits of the use of the site. The events are subdivided into incidents; each incident further defines the content of the event. The incidents and events in the episode of Waterfall Cave appear to be as follows:

Event 1. The cave was first used as a temporary camp for one or possibly two nights. Incidents: stone tool manufacturing and use; eating.

Event 2. The cave was used as a burial place for Burials 8–10, changing the cave from a temporary camp to a burial site. To include all the burials in a single event would seem unjustified since ten deaths at one time could be a major disaster to a small population and perhaps one which might be best explained by a serious disease. There is no evidence of disease on any of the bodies. The multiple burial (Numbers 8–10) is chosen as the second event since the spatial distribution of the burials may best be conceived of as paralleling the temporal distribution of the bodies, that is, those closer to the rear of the cave are earlier than those toward the mouth. *Incidents:* A family group was interred; the interment took place in the fall months on the basis of acorns in situ; a slight depression was made in the cave deposits; mats were laid in the depression; the family was placed in the mats; corn cobs were placed with the family; the mats were folded over the family; additional mats were placed on top; stones were placed on top of the mats (Fig. 3); some deposit was scooped up and over the mats and stones. The fire and broken sherds may be ceremonially related to either this event or Event 3.

Event 3. Once the cave was established as a burial place it was used for additional interments. There is some question as to whether the remaining bodies (Numbers 1–7) were interred at the same or at different times. This is in part due to the disturbed nature of the interment. They are arbitrarily presented as incidents in a single event, although the event must be conceived of as having a considerably longer duration than Event 2. Regardless of the duration of the event, the incidents may be thought of as paralleling in time the spatial distribution. *Incidents:* Burial 6; Burial 1; Burial 7, Burial 3, Burial 4; Burials 2 and 5. Details of each incident cannot be presented in any detail due to the disturbed nature of the interments. The formal elements of the complex, as described under "Burials" appear to be present, suggesting circumstances similar to those detailed in Event 2. The episode ends with the last burial.

Testing the above analysis is best achieved by analogy to the present practices of the Tarahumara. Using the Tarahumara does not imply an assumption of a direct historial continuity. They have been chosen because they presently occupy the same ecological niche and represent a comparable level of cultural complexity.

The Tarahumara utilize dry caves as temporary camps, burial places, and summer residences (Bennett and Zingg 1935: 5, 15, 237). It may be inferred that the knowledge of the whereabouts of suitable burial caves arises from the use of such caves as temporary camps. Judging from the Tarahumara attitudes toward death, a burial place, once designated as such, is no longer used as a temporary camp. Since large caves are scarce, and smaller caves relatively abundant in the area, the larger caves tend to remain sites for summer habitation. Although the formal elements in the treatment of the dead vary among groups of Tarahumaras with varying intensities of acculturation, a number of the elements have analogs in the Waterfall Cave site. They are: (1) blanket wrapping of the deceased; (2) placing food with the deceased; (3) building a fire in the cave for the dead; (4) successive burials in a cave after an initial burial (Bennett and Zingg 1935: 236–51). Tests by analogy cannot be conclusive. Nevertheless, the above tests seem to be sufficient to demonstrate the likelihood of the analysis.

Ecological Analysis. Even if the episode approximates more closely the suggested maximum date than the minimum date, the cultivation of corn, squash, and beans required an intimate ecological adaptation. Although rain is sufficient, the soil is shallow and stoney and the rugged *barrancas* provide few tracts suitable for cultivation. The faunal remains, fishhook, cactus, and yucca indicate that hunting, fishing, and gathering supplemented the cultivated staples. In the absence of direct archaeological evidence, reference to the ethnographic present in the same ecological niche may be suggestive.

The settlement pattern and societal units of the Tarahumara, are chiefly determined, according to Bennett and Zingg (1935: 14) by the fact that arable land is available only in small scattered pockets. This circumstance has inhibited the development of sedentary patterns. The Tarahumara are referred to as "nomadic agriculturists" who migrate within a circumscribed area. The migratory pattern, in turn, has limited the societal unit to independent families that join into larger units on occasion (Bennett and Zingg 1935: 14). Even now, the difficulties of practicing agriculture are sufficient to dissuade Mexican settlement. Population density in this region of the Sierra is less than one person per square km. It is suggested that the societal and settlement units in the past were not at great variance with the ethnographic present.

Acknowledgments. Funds for the excavation were made available by the Department of Anthropology and Sociology, University of California, Los Angeles. We are grateful to the Instituto Nacional de Antropología e Historia of Mexico for authorizing the excavation and allowing export of the collection for study. The site was brought to our attention by Thomas Hinton and John Kennedy who made an ethnographic survey of the region in 1957. C. W. Meighan encouraged and assisted in both planning and analysis and in critical reading of the text. We wish to thank H. C. Cutler for the cultivated plant analysis; Mildred Mathias for the analysis of uncultivated plant material; Dorris Clune for the analysis of the textiles; and to Domingo Samarón, our host at the site, special thanks is rendered.

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TEXTILES AND MATTING FROM WATERFALL CAVE, CHIHUAHUA

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Abstract

The 32 specimens from Waterfall Cave include apocynum-fiber textiles, cane and palm-frond matting and braids, a yucca-fiber leader on a fishhook, and a girdle or string apron. The matting is twilled; the textiles are plain weave and generally warp face. Technical aspects of these specimens are similar to those of textiles from Chihuahua published by Lila O'Neale in 1948. Pattern weaving is the only major new element found at Waterfall Cave.

THE TEXTILES and matting here analyzed include not only the 20 specimens excavated by Ascher and Clune (1960) during the summer of 1958, but also 12 surface specimens recovered from the cave in 1957. Location of each specimen is given in Table 1.

These materials fall into two separate categories: matting and braids of palm frond or cane material (Specimens 1–4, 6, 7, and 28–32 a, b; Table 2), and woven vegetable-fiber textiles (Specimens 5–14, 16–18, 20–27; Table 3). Specimens 6, 7, and 32 a, b (not included in detailed chart) are crude 3-strand braids of palm frond, none of which measures more than 8 inches in length. These braids were on top of the matting covering Burial 8. Specimen 15 is a yucca-fiber leader on a cactus spine fishhook (Fig. 1 *a*); Specimen 19 consists of the string ends from the girdle (string apron?) from Burial 9. These two items are considered separately from the general table. Numerous very small textile fragments in the collection were not numbered or described; all are plain weave and undecorated, and conform to the general description.

Table 1. Provenience of Specimens

Provenience	*Specimen Number*
Surface	1–5, 18, 20-26, 28–32
Pit 1	8, 11, 16
Pit 2	9, 10
Pit 3	12, 27
Pit 4	—
Pit 5	13, 14
Pit 6	15, 17
Pit 1A	6, 7
Burial 9	19

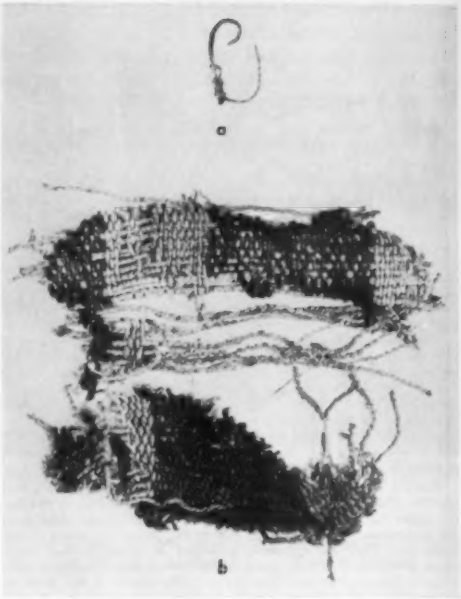

Fig. 1 [Clune]. Fishhook with leader and textile fragment from Waterfall Cave. *a*, cactus-spine fishhook with 2-ply Z-twist yucca fiber leader; *b*, fragments of textile made of apocynum and animal fiber, plain weave, weft face, weft banding in black and gold.

All textile samples are in fair condition. In no case were there any complete selvages, so original sizes of the pieces are not known. Some specimens are brittle and obtaining a length of warp or weft with which to work was difficult. Most specimens are badly worn or stained, therefore nothing is said about color in the technical description except in pattern stitching. The original colors seem to have ranged in general from yellowish-buff to soft medium brown. The technical aspects of these textiles are generally similar to those described by O'Neale (1948). These similarities may be listed as follows:

1. *Fiber*: apocynum. The only exception to this (other, of course, than the matting and braid samples) is Specimen 14 in which the warp is apocynum but the dyed weft banding is animal fiber (Fig. 1 *b*).

2. *Yarns*: with few exceptions 2-ply, S-twist, (single, Z-twist), medium-hard twist.

3. *Weave*: plain, warp face. Again there are inconsistencies. Double warps sometimes appear in the main body of the fabric; also weft floats occur which seem to be technical faults rather than an attempt at patterning.

TABLE 2. MATTING SPECIMENS

Specimen Number	*Fiber*	*Weave*	*Edge Finishing*
1	palm frond, elements from 1/4 to 7/16 inch in width	diagonal twill, 3 x 3	rounded starting edge; each element at edge twisted over and back to re-enter body of mat as opposite element; fill-in elements for center portion of mat laid in, leaving the end free in back
2	palm frond, elements from 3/16 to 1/2 inch in width	diagonal twill, 3 x 3	same as Specimen 1
3	cane, elements from 11/16 to 1 inch in width	twill, 2 x 2	end turned to underside and caught by cross element
4	palm frond, elements from 3/8 to 3/16 inch in width	diagonal twill, 3 x 3	same as Specimen 1
28	palm frond, elements from 1/8 to 1/4 inch in width	diagonal twill, 3 x 3; reverse 4 inches from edge	double edging, each set of elements finished separately
29	Yucca (?), elements from 1/16 to 1/8 inch in width	diagonal twill, 3 x 3	no edges
30	palm frond, elements from 3/16 to 7/16 inch in width	twill, 2 x 2	end turned to underside and caught by cross element
31	cane, elements from 5/8 to 1 inch in width	twill, 2 x 2	ends turned to underside and caught by cross elements

4. *Thread count*: wide range, in most cases number of warps almost double number of wefts per inch.

5. *Edge finishes*: (a) Loom ends (end selvages) — in almost all cases where an end selvage is present there are two definite characteristics, a double weft used as a loom-string and twining elements which are composed of from four to eight strands each catching the warp loops and loom strings at varying intervals. In Specimen 13 this is further reinforced by two strands of 2-ply yarn overcast over the twining element. (b) Side selvages — only Specimens 24 and 26 have side selvages. Both of these have looped edges from multiple wefts and both have evidence of additional 2-ply twining elements over the looped edges. Specimen 26 has a cut curved edge overcast with a single 2-ply yarn.

The only major element which contrasts with O'Neale's report is in the pattern weaving. Only in Specimen 14 of this collection is there a striping pattern, and that is a weft striping or banding, not warp as was characteristic of O'Neale's collection (Fig. 1 *b*). There are two fragments of this piece, and although they were excavated as separate fragments there seems to be little doubt that they are from a common piece. Another design element appears on four of the specimens. This consists of three single yarns (each 2-ply, S-twist) which run in a stair-step pattern alternately with the warp and weft (Fig. 2). These are extra elements, placed as the weaving progressed. Specimen 24 is the most complete example of this but here, as in the other three, the pattern is interrupted by the incomplete edge of the textile fragment. Specimens 15 and 19 do not fit into the general headings of the Tables and must be considered separately.

Specimen 15 is the fragment of a leader on a cactus-spine fishhook (Fig. 1 *a*). The fiber is yucca, 2-ply, Z-twist (as contrasted with S-twist of the woven textile materials). Attachment to the hook is by a Magnus Hitch.

Specimen 19 consists of two ends cut from a girdle or string apron on Burial 9. Because of the tight flex of the burial and general condition of the body, it was impossible to obtain a more complete specimen. Little can be inferred about the length of material that passed around the body. Zingg (1940: 20–1) in describing the string apron skirt in Río Fuerte says:

> The garment hung from the waist by a cord of three strings of spun pita fiber (*Agave sp.*). These waist fibers also served to hold the 34 similar strings of the body of the apron by means of twine-weaving them with the three strings of the waist cord. The resultant down-hanging ends of each of the 34 strings are twisted to-

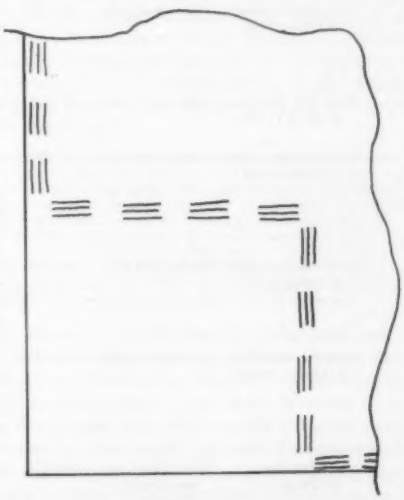

FIG. 2 [Clune]. Stair-step design element on textiles from Waterfall Cave.

Table 3. Textile Specimens

Specimen Number	Condition	Weave	Thread count (per inch)	Edge Finishes	Pattern
	(measurement in inches)				
5	fragment; 10 1/4 by 6 3/8	plain, warp face	24 x 16	none	Figure 2; pattern element of slightly deeper color than background
8	fragment, one edge; 4 3/8 by 6 1/16	plain, warp face	28 x 16	loom end: warp loops twined with two groups of yarns, five strands each, every three warps; double weft as loom string	none
9, 10*					
11	fragment; 10 5/8 by 11 3/4	plain, warp face	32 x 16	none	same as Specimen 5
12	fragment; 3 7/16 by 5 7/8	plain, warp face	24 x 16	none	none
13	fragment, one edge; 5 1/4 by 7 3/8	plain, warp face	24 x 16	loom end: warp loops twined with two groups of yarns, one with eight strands, one with six strands; two extra strands overcast over twining	none
14a, 14b	fragments; a — 1 5/8 by 3 7/8 b — 1 3/8 by 3 1/2	plain, weft face	26 x 12	none	weft stripe; Figure 1 *b*
16	fragment; 7 3/4 by 9 1/2	plain, warp face	28 x 12	none	none
17,* 18	fragment; 7 7/8 by 6 1/2	plain, warp face	32 x 16	none	none
20	fragment; 9 7/8 by 6 3/4	plain, warp face, 1 double weft	28 x 14	none	none
21	fragment, one edge; 13 by 14 1/2	plain, warp face, weft floats	28 x 12	loom end: no sign of twining; eight rows of filler weft, 2-ply (x 2), S-twist	none
22	fragment, one edge; 5 1/2 by 5 5/8	plain, warp face	36 x 16	loom end: double weft as loom string, twined with two groups of yarns, one with four strands, one with five strands, every three warps	none
23	fragment, one edge; 10 5/8 by 13 5/16	plain, warp face	25 x 12	loom end: double weft as loom string, no signs of twining	none
24	fragment, two edges; 20 1/4 by 11 5/8	plain, warp face	32 x 18	loom end: double weft as loom string, twining with two groups of yarns, five strands each; side selvage: looped with multiple wefts, twining finish, six and seven strands	same as Specimen 5
25	fragment, two edges; 46 1/4 by 33 3/8	plain, warp face	24 x 20	loom end: double weft as loom string, twining with two groups of yarns, five strands each; side selvage: looped with multiple wefts, evidence of twining	none
26	fragment, two edges; 30 13/16 by 35 5/16	plain, warp face	28 x 16	loom end: double weft as loom string, twining with two groups of yarns, one with four strands, one with six strands; side edge: cut in curve and overcast with single 2-ply yarn	none
27	fragment; 14 1/4 by 7 5/8	plain, warp face, some double warps	24 x 12	none	none

* Small specimen, plain, warp face, no edges or patterning.

gether forming a single two-ply cord. In summary, this produces an apron of 34 two-ply strings hanging from a triple waist cord to which they are attached by twined weaving.

In the present specimen the basic element is a 2-ply Z-twist yarn, approximately 50-plus in one group, 40-plus in the other. The extremely fragile condition of the specimen makes it impossible to pull the yarns apart for an exact count. Through knotting or retwisting these 2-ply yarns together, this large number of yarns has been reduced, for each piece, to approximately ten now cord-thick elements, in the 6½ to 7 inches between the natural lower end and the top end where it was cut from the burial.

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CULTIVATED PLANT REMAINS FROM WATERFALL CAVE, CHIHUAHUA

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ABSTRACT

Cultivated plants from Waterfall Cave include several varieties of maize, common beans, bottle gourd, and squash. Most of the corn is of the Pima-Papago race, and the whole plant complex is similar to the group of cultivated plants recently grown by the Papago and other Indians of southwestern Arizona and northwestern Mexico.

THE CULTIVATED plant remains (corn varieties, common beans, bottle gourd, and squash) from this site are similar to those grown until recently by the Papago and other Indian groups of southwestern Arizona and northwestern Mexico. Most of the cobs (Fig. 1 *a*) and fragments are of the soft flour corn described as the Pima-Papago race (Anderson and Cutler 1942; Carter and Anderson 1945) or as Mais Blando de Sonora (Wellhausen, Roberts, and Hernandez 1952). Lumholtz (1902, Vol. 2: 280) illustrates two ears grown by the Huichol and similar ears are grown occasionally today as far north as the Hopi and Zuni Pueblos, and less frequently by the Rio Grande Pueblos. The grains are usually cream-white, often yellow, sometimes red or the color of black cherries, or variegated. There have been gradual changes in this race over the years but many of the collections taken from early Basketmaker sites of Arizona and Utah, from Ventana Cave, Tularosa Cave, Point of Pines, and other sites belong to this race.

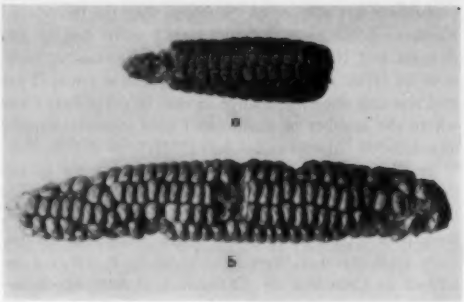

FIG. 1 [Cutler]. Corn from Waterfall Cave, Chihuahua, and Sacaton, Arizona. *a*, only intact ear from Waterfall Cave, belonging to the race called Chapalote, but showing a mixture with the Pima-Papago and Harinoso de Ocho races; *b*, ear of Pima-Papago race, grown by Pima Indians near Sacaton, Arizona, in 1913. Length of *b*, 6⅛ inches.

The mixture of corn from the Waterfall Cave site can be best understood by reviewing roughly the history of corn as revealed by collections from sites in the area and in Arizona and western New Mexico. The earliest corn is usually considered to be relatively free from contamination with teosinte and has been called "pure maize." Later, the race called Chapalote appears (Wellhausen, Roberts, and Hernandez 1952; Mangelsdorf and Lister 1956) and spreads quite widely in the Southwest. Chapalote was grown in fields in which teosinte occurred as a weed and Reventador (Anderson 1944; Wellhausen, Roberts, and Hernandez 1952) is a race which resulted from this intermixture.

Galinat, Mangelsdorf, and Pierson (1956) point out this growing amount of teosinte (or Tripsacum) germplasm in several sites of central Arizona. This infiltration of teosinte germ-plasm into corn is still going on near Waterfall Cave and in other parts of Mexico where teosinte is a weed in corn fields. Lumholtz (1902, Vol. 1, 429) gives this account:

> Around Nabogame grows a plant called *maizillo* or *maizmillo*. It is more slender than the ordinary corn plant and the ears are very small. It grows among the corn and has to be weeded out, as it injures the good plants. However, several Mexicans assured me that, when cultivated, the ears develop. After three years they grow considerably larger and may be used as food. A man in Cerro Prieto raises this kind only; others mix it with the ordinary corn. I was told that people from the Hot Country come to gather it, each taking away about one almud to mix with their seed corn. The combination is said to give splendid results in fertile soil.

A soft-flour corn, Harinoso de Ocho, with eight rows of grain, probably introduced from South America, crossed with Reventador, Chapalote and teosinte, to produce the most common corn of the Waterfall Cave site, the Pima-Papago race. Harinoso de Ocho had many advantages as a food source. The soft-flour grains could be prepared in many ways and as toasted grains, were undoubtedly easier to prepare, carry, and eat than the hard flint or pop grains. The hybrid Pima-Papago race, which has grains similar to those of Harinoso de Ocho, was

probably better adapted to the region than the introduced Harinoso de Ocho and could spread more rapidly into Arizona and New Mexico. Later, when strains of Harinoso de Ocho were adapted, these spread northward too and one can trace the change in sites like Tularosa Cave where the number of eight-rowed cobs increases rapidly after A.D. 500 (Martin and others 1952).

Small amounts of the flinty-hard Reventador in hybrids with Harinoso de Ocho produced the variable Pima-Papago race (the Mais Blando de Sonora of Wellhausen, Roberts, and Hernandez 1952). Larger amounts of Reventador germ-plasm in these hybrids results in the race described as Cristalina de Chihuahua, a race which has been found in corn described from sites in northwestern Mexico (Mangelsdorf and Lister 1956). While this variety and Reventador are rarely found today among the Papagos of southern Arizona, they were common about 40 years ago and a complete series of the steps from Reventador through Cristalina, Pima-Papago to Harinoso de Ocho can be seen in collections made among the Papago about 1913 and now in the collections of the Missouri Botanical Garden (Fig. 1 *b*).

About A.D. 1000 a large-cobbed race of corn called the Pueblo race (Anderson and Cutler 1942) spread over the Southwest. This race is grown mostly by the Pueblo Indians, but came originally from Mexico. The Waterfall Cave cobs which appear to belong to this race may represent Mexican races introduced from the south or after A.D. 1000 Pueblo race corn brought from the north, most likely after 1100 when the principal movement of this corn into some areas appears to have taken place, and perhaps even as late as the 1800's when the Apaches carried Pueblo corn on their moves. The Pueblo race of corn is practically never grown by the Papagos, Yumans, Cocopas, or Maricopas, but is frequently grown by Mexican families of the upper Rio Grande Valley from seed descended from plants grown by the pueblos.

In the diagram (Fig. 2), the specimens above the heavy line may be considered to belong to the Pueblo race, although all of these show some mixture with other races and may often resemble in external appearance ears which are typical of the Pima-Papago race. Among the Pueblo Indians, from the Hopi villages to the Rio Grande, one can see ears which are similar to those grown by the Papagos of southern Arizona and northern Mexico, but which differ by having larger and harder butts and cobs, wider cupules, and other less apparent characters of the Pueblo race of corn. To the extreme lower left of Figure 2 are three cobs which can be considered as Reventador. To the right, practically all of the 8-rowed cobs can be considered as Harinoso de Ocho. All the rest of the cobs are of the Pima-Papago race with the exception of a few which probably are Cristalina de Chihuahua but which cannot be separated with certainty because these specimens lack grains. The only complete ear is a small-grained one of the Chapalote race but there is a single loose grain of Reventador (or a small-grained Cristalina?), and two slightly dented grains of the Pueblo race.

If more corn material, preferably in large quantities from dated sites in this area, can be located it will tell how and when the many kinds of corn were carried into the Southwest and the direction and intensities of the various migrations through this region.

The sole gourd fragment (*Lagenaria siceraria*) is relatively thin (2.5 mm.) and probably came from a small gourd, perhaps one of the smaller ones used so commonly for carrying small amounts of water. The only squash which could be identified is *Cucurbita mixta*, and the single seed is of the group to which the green-striped cushaw belongs. This variety is the most recent of the squashes to appear in sites in the greater Southwest (Cutler and Whitaker 1956; Whitaker and Cutler 1957). The squash rind fragments could belong to any of the three annual species which are known to have been cultivated in northern Mexico in prehistoric times. Two common bean pods were found. Teparies probably were grown, too, as they are grown farther north by the Papagos. A

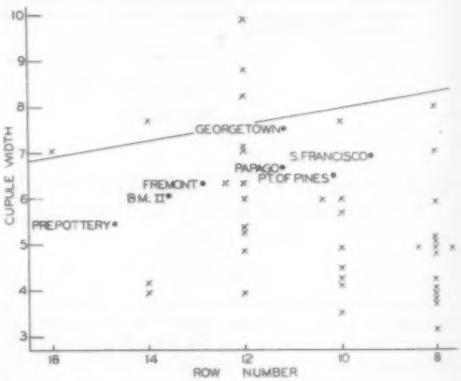

Fig. 2 [Cutler]. Diagram showing the number of rows of grains and the cupule width of corn cobs from Waterfall Cave (x) and the averages (o) for several collections of modern and archaeological corn from the Southwest. Cupule width, the measure of the cob cavity in which a pair of grains is borne, is measured in millimeters as described by Nickerson (1953). Most of the collections used for comparison appear in a chart by Cutler (1957). These collections are: *Fremont* — an average for a selection of cobs from Yampa Canyon sites; *Georgetown* — an average derived from a large collection of cobs from the Georgetown phase (A.D. 500–600) of Tularosa Cave, New Mexico (Martin and others 1952); *Papago* — an average for soft flour corn collected from the Papago Indians of southern Arizona in 1913 and in 1953; *Point of Pines* — an average for some charred cobs from Room 70 of Arizona W:10:50, dated about A.D. 1285, excavated by the University of Arizona Archaeological Field School; *Prepottery* — an average for many cobs from prepottery levels of Tularosa Cave, perhaps from about 400 B.C. or earlier; *San Francisco* — an average for a large collection of cobs from the San Francisco phase of Tularosa Cave, A.D. 1000–1200.

fragment of a cactus (*Opuntia* sp.) pad was found. This single specimen tells little, for cacti and many other wild foods were and still are utilized by people living in environments like that about this site.

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March, 1960

EARLY PARACAS TEXTILE TECHNIQUES

DWIGHT T. WALLACE

ABSTRACT

A textile recently found undoubtedly relates to an early phase of the Paracas style of the Peruvian south coast. The decorative techniques consist of slit tapestry, brocade, and warp striping. The tapestry design is a complex feline figure with various traits of the Chavín style. The techniques and design are of considerable interest since no Paracas textile of this or earlier date has been previously published.

IN 1957, while I was working on an archaeological survey of the south-central Peruvian coast under a Fulbright grant, I noted that a local *hacendado* was getting a large collection of Paracas grave pottery from local *huaqueros*. I could not find out exactly where the pottery was coming from, but I asked that the *huaqueros* bring samples of the perishable materials from the graves. Among the resulting materials was a textile fragment of particular interest for its tapestry design of a Chavinoid feline (Fig. 2 *a*).

When various items of information are taken into account, the following can be claimed for the textile: (1) It came from the Callango region of the lower Ica valley, where recent pot-hunting activities have turned up pottery identical to that with which the textile was presumably associated; (2) It belongs to an early phase of the Paracas style, either the earliest known phase, Cerrillos, which I have recently identified in excavations in Ica, or the following T–1 or T–2 phases (Rowe 1958) — it is very unlikely to be as recent as the Paracas "Cavernas" or T–3 ceramics. The reasons for the dating are: (a) that certain design elements of the tapestry figure are comparable to ones on the ceramics of the time period in question; (b) that the general character of the design suggests an early dating, following the recent evidence that Chavinoid influence was much stronger in the earliest Paracas phase; (c) that the ceramics with which the textile was presumably associated are of the Cerrillos, T–1, and T–2 substyles only; (d) that a very similar brocade design to that of the all-red panel on the present specimen, plus examples of tapestry and warp striping, were associated with ceramics of the T–1 phase in the excavations at the Cerrillos site; and (e) that the textile is not similar in design to those known from any other period.

The textile is a relatively large, irregular fragment (Fig. 1). The main web is basically a plain weave and measures 60.8 cm. long (incomplete loom length) and 45.8 cm. wide (complete loom width). A tapestry panel apparently extended across the web from selvage to selvage (Fig. 1 *a–c*); the panel is 12 cm. high. There are three rectangular units of brocade, none complete (Fig. 1 *d–f*); there were undoubtedly at least four of these units originally. The dimensions of the brocade units vary slightly from 7.3 by 12 cm. to 7.5 by 10.5 cm. The two upper panels have one type of design (Fig. 2 *c*), the lower panel another (Fig. 2 *b*). A scrap from the selvage of a second

web is stitched to the selvage of the main web (Fig. 1 g); the scrap shows warp striping. The technical details of the specimen are as follows:

YARNS

Base: 2-ply; Z-spun, S-doubled; medium twist; 0.3–0.4 mm. thick; cotton; natural pale tan.

Design: 2-ply; Z-spun, S-doubled; medium twist; 0.6–0.7 mm. thick (tapestry and warp stripe), 0.7–1.0 mm. thick (brocade); wool; red, dark red, yellow, black, brown, white, and light green.

Functional Stitchery (sewing): 3-ply (2–2); Z-S-Z; 0.9 mm. thick; cotton; pale tan.

WEAVE

Base: plain weave (1x1); 22 warps by nine wefts per cm.; plain weft selvage with warps compacted to 29 per cm.; warp selvage missing.

Tapestry: slit (kelim); six warp units (each of four warp yarns) by 24 wefts per cm.; all colors used.

Brocade: Red yarns are simple under-float and over-float in most areas; the yarns in some spaced lines of work within the panels, plus the solid upper and lower borders, are wrapped around the warps, regularly over 12 warps and back under six in the borders. The black, yellow, and light green brocade yarns are over-two, under-two, are not under-floated from one color area to another, and are inserted in areas in which the red yarns, which are continuous from border to border, are under-floated. The result is a single face design.

Warp Striping: warp-face plain weave (1 x 1); 26 warps by six wefts per cm.; red and tan stripes.

Functional Stitchery: whipping stitch; stitches spaced about 6 mm.

All of the supplementary yarns which have been identified as brocade could have been duplicated by embroidery. The "wrapping" technique creates an effect like embroidered stem stitching; it is an unusual technique and is brocade only in having been laid in as supplementary yarns during weaving. The over-2, under-2 brocading, combined with the lack of under-floating between the narrow color areas, suggest a double-running stitch in embroidery. The identification of the techniques as brocade is based on various factors. The most telling is that two weft shots of the ground cloth in the area between units *d* and *e* do not extend across the web, but are turned back just at the border of the brocade panels; this situation could occur only if the supplementary yarns were inserted during weaving, by the brocading technique. These extra weft shots were undoubtedly meant to offset the less compact wefting which was occurring in this area due to the added bulk of the supplementary design yarns in the same shed.

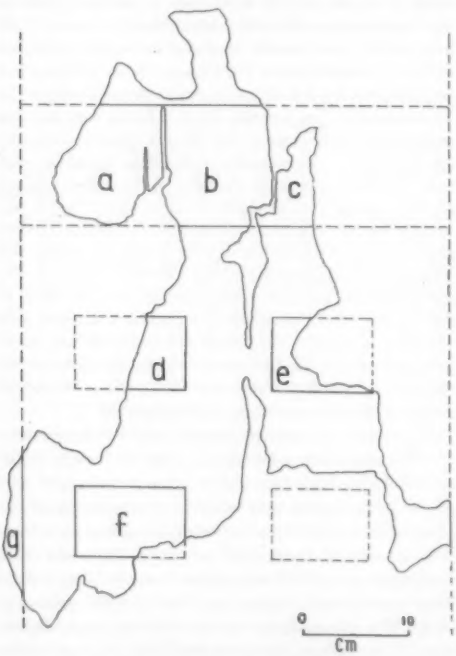

Fig. 1 [Wallace]. Outline of early Paracas textile fragment.

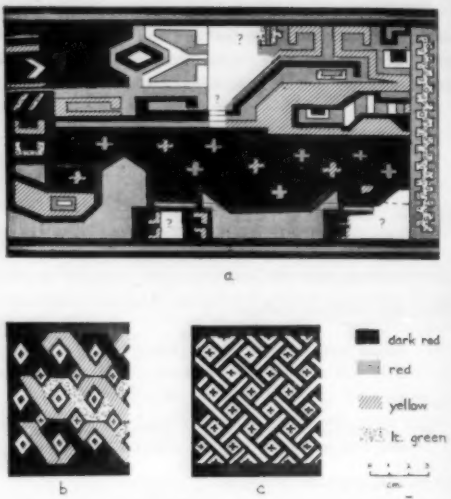

Fig. 2 [Wallace]. Designs on early Paracas textile. *a*, tapestry; *b*, *c*, brocade.

Therefore, if the under-floated and over-floated lines of work are brocading, the lines of wrapping must also have been inserted during weaving, since the yarns are continuous between the lines of work in the two techniques. In addition, the wrapped yarns always pass between the same two wefts, and all the design details of panel *d* fall between the exact same ground wefts as the corresponding details in panel *e*. All these features would be unusual, although not impossible, if the supplementary yarns had been inserted by embroidery.

The reason for identifying the black, yellow, and green supplementary yarns as brocading is based mainly on the facts that none of the colored yarns cross or split the red yarns which are under-floated in the same areas; that all of the supplementary yarns pass between the same wefts in each line of work; and that there are always two lines of work between each pair of ground wefts. Again, em-

broidery is not likely to have been done so carefully so as to produce these features.

The specific full-figure profile feline represented on this textile is unique among Peruvian textile designs (or ceramics, for that matter). It is most similar to some relief designs on Chavín stone stelae (especially Tello 1929, Pl. 37) in the full profile figure, bared teeth with protruding fangs, eccentric-pupiled eye motif on the nose and various other parts of the body, the long segmented tail, and the recurved ray appendages on back and head. The crosses on the body do not appear to occur on Chavín relief work, but do occur on one three-dimensional stone feline in the Chavín style (Tello 1929, Pl. 27). There is a basic style difference between the angularity of the textile design and the very curvilinear character of the Chavín stone designs, but the difference in media could explain this situation. The angular recurved ray motif also occurs frequently on ceramics of the T–1 and T–2 phases of the Paracas style. The chevron motif here occurring over the tail of the feline is generally associated with Tiahuanacoid styles, but also occurs in the Paracas style to represent a plaited tress of hair.

The textile described here is the only one of sufficient preservation to give an idea of early Paracas textile designs. The techniques involved fit the recent unpublished data which indicate that tapestry, brocade, and warp striping were among the textile techniques of the period (along with plaid, warp-pattern weave, gauze, and sprang). The feline design adds one more example of Chavín-style influence on the south coast; and it suggests a textile iconography which is at least partly distinct from that of the ceramics, a fact which must be taken into account in purely stylistic analyses of Paracas art.

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A MISSISSIPPIAN HOUSE FROM WESTERN MISSOURI

J. M. Shippee

Abstract

A small rectangular house floor at the Gresham site, north of Kansas City is assigned on the basis of associated artifacts to the Steed-Kisker focus of Middle Mississippi. The house differs architecturally from the house at the Steed-Kisker site described by Wedel. These differences and other evidence point to the possibility of major cultural transitions in the area during Middle Mississippi time.

IN 1938 A HOUSE FLOOR was uncovered at the Steed-Kisker site by Marvin Kivett and Karl Schmitt under the direction of Waldo Wedel. It was of the usual Nebraska aspect type of semi-subterranean earth lodge, nearly square with rounded corners and a southern entrance. Four center posts and a central fireplace were other features. The house had been built on rather low ground in the village area, but another house, which had been extensively damaged by road construction, was located on much higher ground on the slope of the nearby hills.

For many years R. B. Aker of Parkville, Missouri, a member of the Missouri Archaeological Society, had found evidence of Indian occupation along the sloping terrain bordering White Alloe Creek which enters the Missouri River flood plain a half mile south of the excavation described here. This evidence consisted of potsherds, projectile points, a clay elbow pipe, and flint flakes. At this particular site, the property of Warren Gresham, burned clay daub, presumably from a wattle-and-daub structure, was found on the surface of a plot of ground which had been plowed for a garden. Some erosion was evident, but it had not been serious even though the land sloped one foot in ten. Aker's preliminary testing at the site revealed 2 to 6 inches of daub covering an area 14 by 22 feet, and beneath this burned clay a fairly level floor seemed to occur at a depth of 8 to 21 inches. After removing most of the overburden, Aker asked Terrance Dyche (Kansas City) and me to assist him in excavating the Gresham site (23PL48).

The fire which had leveled the house evidently had been quite intense for several posts had burned down beneath the floor and in many places the earth about the postholes was a very noticeable red. Charcoal was abundant in scattered fragments and in the completely charred sections of small logs and poles which were found in horizontal positions. The only evidence of a central fireplace was located 8 inches below the general floor level where the subsoil was reddened by fire. Aker had made a test at this place which was dug to a few inches below

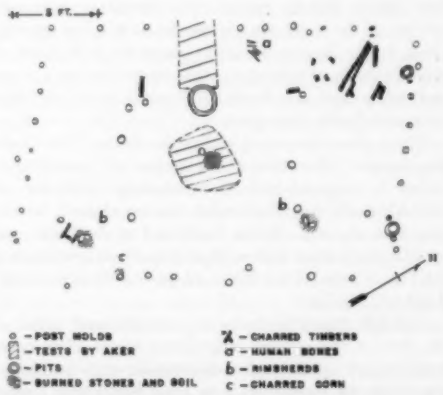

Fig. 1 [Shippee]. Plan of Mississippian house, Gresham site, western Missouri.

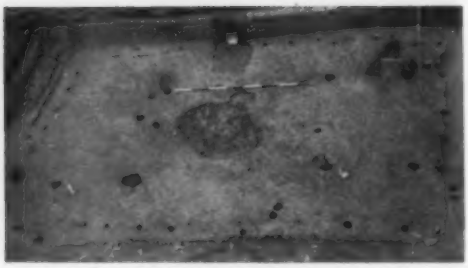

Fig. 2 [Shippee]. View of Mississippian house, Gresham site.

the floor level but he could not recall evidence of a fireplace. A posthole 4 inches in diameter and 15 inches deep at the edge of the fire-reddened area in the center of the house could have been the location of a post used in cooking. Two other locations that were possibly fireplace areas within the house were marked by a few small fired limestone slabs lying on the floor. At these places artifacts occurred more numerously and the floor seemed to be littered with more debris than elsewhere. The location of these possible fireplaces (Figs. 1, 2) suggests that two families may have occupied the house.

Five of the posts in the structure were located by the charred remnants standing upright in place; 43 others were located by the red burned earth about many of the holes and the mixture of refuse which had fallen into the holes left by the rotting wood subsequent to the fire. A few posts possibly were removed during occupancy of the house and the holes filled with earth and trash. Some of the postholes were only a few inches deep and indicated that the post was probably pointed at the base. One post, of an approximate diameter of 3 inches, had been placed in a hole 18 inches deep and large enough that the fill around the post had contained a fair sized rim sherd (Fig. 3 *b*) as well as flint flakes and spalls. This posthole indicated that the base of the pole was crooked or that the post leaned slightly inward. The intended rectangular pattern of the outer posts of the house is quite apparent (Figs. 1, 2). Four posts with a diameter of 6 inches or more could have been the central roof supports, but several others were also located within the house and their purpose is highly conjectural.

Three pits were found within the house. The largest was located 3 feet west of the center and measured 18 inches in diameter and 26 inches deep. This pit was cylindrical and was filled with a mixture of earth, burned clay, and charcoal. At the north end of the house, two pit-like places filled with earth and daub occurred close to the line of posts. They had a diameter of 9 inches and a depth of 18 inches.

The fully flexed leg bones of a juvenile were found on the floor at the western edge of the house. The bones were in poor condition and the articular ends were missing. In direct association with these bones was a small vessel of a type which has been found previously associated with child burials of the Steed-Kisker focus (Shippee 1959: 3–10) and at the Steed-Kisker burial ground (Wedel 1943: 95–7). This restorable vessel had been crushed and appears to have been in a fire. The style and decoration are suggestive of Cahokia Old Village ware (Fig. 3 *a*).

Other pottery fragments which occurred on the floor of the house and in the fill of the postholes are reminiscent of pottery from the Steed-Kisker site, but vary in some ways which seem worthy of comment. The vessels were all of a size suitable for utilitarian purposes and are smooth and shell tempered. Color, texture, and hardness are similar to the range of the Steed-Kisker ware, but the pronounced shoulder, observed so frequently at the type site, and the chevron decorations are not a dominant characteristic of the pottery from the Gresham site house (Fig. 3 *c*, *d*). The vessels have the globe-like body of many Nebraska aspect types which occur on the type sites of that aspect in eastern Nebraska. These Nebraska aspect vessels are most frequently grit-tempered, and the surface is resmoothed after being cord marked.

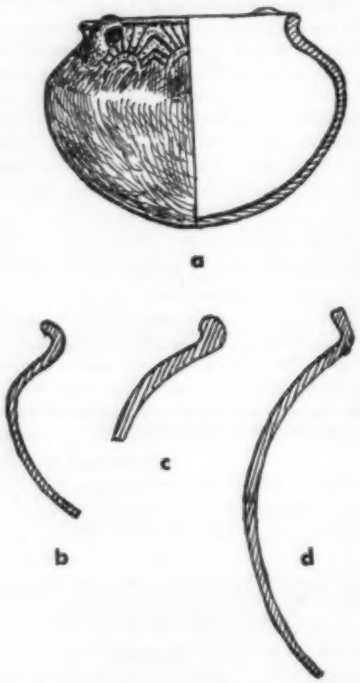

Fig. 3 [Shippee]. Pottery from Gresham site. *a*, vessel restored from sherds associated with human bones on house floor, unpolished, incised, diameter of body, 12.7 cm.; *b*, rim from posthole fill, smooth surface, diameter of body, approximately 15.2 cm.; *c*, rim restored from sherds on floor and in a posthole, smooth surface, diameter, approximately 30.5 cm.; *d*, rim of globe-like vessel from floor, gray-brown, smooth surface, diameter, approximately 30.5 cm.

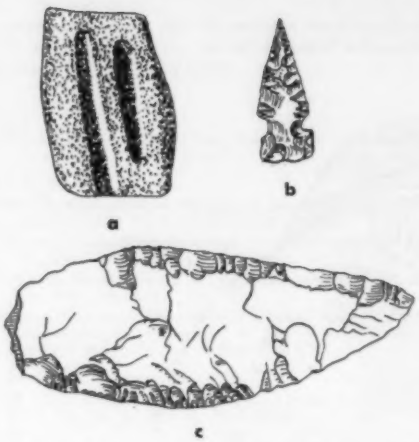

FIG. 4 [Shippee]. Artifacts from Gresham site. *a*, sandstone abrader; *b*, side-notched flint projectile point; *c*, flint knife with four-way bevel. Length of *c*, 8 cm.

Other diagnostic artifacts recovered in the house at the Gresham site are one complete projectile point and the base of another which are like those from the Steed-Kisker site, a four-beveled flint knife, and two sandstone abraders (Fig. 4). Bone tools and scrap animal bone were noticeably absent. A few charred hickory nuts were found, and charred corn was discovered on the floor adjacent to the east wall near one of the possible fireplaces.

The small rectangular house floor which was uncovered at the Gresham site seems more in keeping with Middle Mississippi traditions than the semi-subterranean square earth lodge floor found at the Steed-Kisker site by Wedel and Kivett, but artifacts from the two houses are seemingly of no aid in determining which type of house was characteristic of the Steed-Kisker focus. Wedel (1943: 75–9) did not describe any of the 1271 potsherds from the midden filling the house pit at Steed-Kisker as being characteristic of the Nebraska Aspect focus. He has, however, identified large rim sections of vessels from the Kansas City area as being similar in shape to a type from the sites in eastern Nebraska. His identification of these large rims has been substantiated since then by my observations of material from numerous sites near Kansas City where a confusing mixture of the sherds of the two complexes occurs on the surface. Further exploration in northwest Missouri will be necessary to determine the house type or types in general use at the contemporaneous Steed-Kisker and Nebraska aspect sites of the area.

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December, 1959

ROUTES TO BERING STRAIT

CHESTER S. CHARD

ABSTRACT

Maximum glaciation in eastern Siberia, the final glaciation, the mountainous area, and the land area exposed by moderate lowerings of sea level are plotted on a map to illustrate that two routes from northeast Asia to northwest North America were available for human movements. The southern route along the coastal shelf may have played a more significant role in the initial settlement of the New World than did the northern route along the Arctic shore.

THE NATURE of the Bering land bridge and its availability for early human movements have been ably discussed in recent publications (for example, Byers 1957, Hopkins 1959). Little consideration has so far been given, however, to the problem of how and when early men could have reached the straits area in the first place, and, as a corollary, where traces of their passage could most profitably be sought on the Asiatic side. The general absence of early remains in northeastern Siberia has previously been noted (Chard 1956), and present evidence suggests that the centers of terminal Pleistocene population in Siberia lay a good 2000 air line miles from Bering Strait — still further, of course, by any feasible land route in this difficult region.

The accompanying map (Fig. 1) indicates the limited nature of even the maximum glaciation in eastern Siberia, as well as the extent of the changes in land areas resulting from quite moderate lowerings of sea level. It will be seen that there was potential access to the strait at all times from the ice-free hinterland of Asia, and that in fact during times of major continental glaciation Alaska might more properly be viewed as forming part of the Old World.

The two feasible routes for human movements are also shown (for a more extended discussion of these, see Chard 1958). Owing to the difficulties of the terrain under present conditions, it seems virtually certain that use of the southern route was confined to periods of lowered sea level when the level coastal shelf was exposed. As a consequence, any traces of early wanderers must be largely submerged. The best prospects for their recovery would seem to lie along the probable overland short-cut across the low-lying gap north of Kamchatka, which I have dubbed "the Koryak Corridor." It is hoped that our Soviet colleagues will take the hint.

The northern route along the Arctic shore, on the other hand, would have been available at any time during the later Pleistocene, though perhaps less inviting under glacial conditions. Even a slight lowering of sea level would create a vast coastal plain in this area, leading to probable dispersal of cultural remains and subsequent submergence of the greater part.

Each of these routes taps a major cultural and natural region of Siberia (Chard, in press), and in all probability each would have been instrumental in transmitting quite different traditions to the New World. The over-all pic-

Fig. 1 [Chard]. Map of the Bering Strait area showing two routes from Asia to North America.

ture at present suggests that the southern route may have played the most significant role in the initial settlement of the New World (Chard 1959).

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May, 1960

NATURAL PRESERVATION OF HUMAN BRAIN, WARM MINERAL SPRINGS, FLORIDA

WILLIAM ROYAL AND EUGENIE CLARK

ABSTRACT

Artifacts of Archaic types, human bones, and a partly burned log have been recovered from three layers of sediments on the floor of a shallow limestone cave now under water. The skeletal remains include a skull from Layer 2 with naturally preserved portions of brain inside. The charred log from Layer 3 produced a radiocarbon date of 8000 B.C. ± 200 years. The age of the preserved brain may not be as great as that of the log and human remains in Layer 3. The radiocarbon date is the earliest known date for man in Florida and suggests that during the early Southeastern Archaic, man lived in limestone caves in Florida when the sea level was considerably lower than at present.

THIS REPORT is based on finds made by Royal while skin diving in Warm Mineral Springs, Sarasota County, Florida. These finds suggest the possibility that during the early Southeastern Archaic, man lived in limestone caves in Florida when the sea level was considerably lower than at present. In Warm Mineral Springs, on the sides of a sloping wall leading into a limestone sink hole, there are ledges and shallow caves containing stalactite, stalagmite, and column formations encrusted with travertine. Some of these stalactites are now under water as much as 80 feet. In a section of one cave, where the floor varies from 35 to 40 feet under water, numerous human bones of at least seven individuals (one child, six adults) were found. These included three skulls (one intact with a cephalic index of 74), parts of mandibles, bones of the upper and lower extremities, vertebrae, pelvic bones, and ribs. No pottery has been recovered. Artifacts include two long bone needles, an antler shaft wrench or atlatl weight, a bone pestle, marked deer bones and antlers, and part of a fossil shark's tooth with a chipped edge (Fig. 1). Except for the shark's tooth these few artifacts show similarity with those found at the Eva site in Tennessee (Lewis and Kneberg 1959). Human bones were located several feet under soft sediment, on or near the solid base rock forming the floor of the cave. After numerous dives and examination of this site we were convinced it was occupied at a time of lowered sea level when the cave was dry.

The sediment varies from about 3 to 7 feet in total thickness and is composed of three distinct layers:

1. A top layer averaging 20 to 40 inches in thickness is composed of extremely soft black sediment with numerous tiny shells of *Amnicola augustina* Pilsbry throughout as well as some alligator bones. Travertine deposits occur in loose chunks and coat stalactite fragments and cave walls in this and the following layer.
2. A middle layer varies from 6 to 18 inches in thickness and is more or less dark gray. It is a more compact and hard layer than the top one and is characterized by the presence of the shells of two species of fresh water snails, *Helisoma duryi* Wetherby and *Physa cubensis* Pfeiffer, which are heavily concentrated in the upper por-

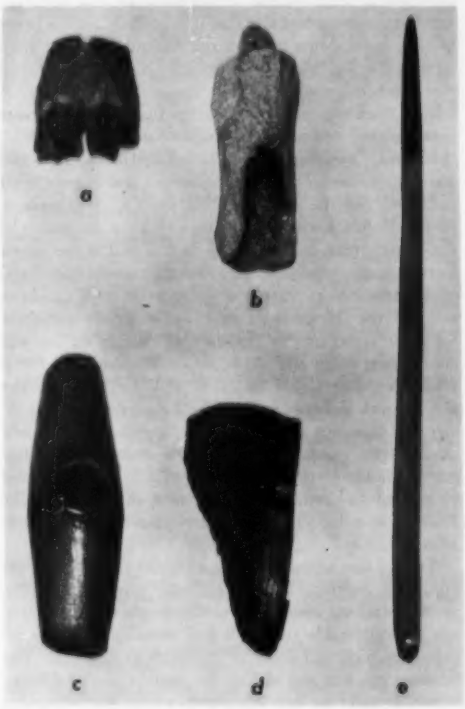

FIG. 1 [Royal and Clark]. Artifacts from Warm Mineral Springs, Florida. *a*, deer bone with cut edge; *b*, bone pestle; *c*, antler shaft wrench; *d*, half a fossil shark's tooth with chipped edge; *e*, bone needle. Length of *e*, approximately 18 cm.

tion of this layer. No *Amnicola* shells have been found here or below. This layer is composed mainly of closely packed leaves of spermatophytes. Bird, deer, and human bones have been recovered as well as pieces of wood, charcoal, and two bone needles. In places, there are clusters of pteridophyte leaves encrusted with travertine, some of which have been identified as probably *Osmunda cinnamomea*.

3. A bottom layer 6 to 20 inches in thickness is sandy in color and also packed with leaves of spermatophytes. Pine cones, hickory nuts, acorns, wood, and charcoal are scattered throughout as well as bones of fresh water turtles, birds, rodents, opossum, raccoon, deer, and man (including the remains of a child). The basal rock on the floor of the cave is a hard limestone with fossil remains of echinoderms, a variety of marine molluscs, and *Carcharodon* teeth. The limestone is in places overlain with hard clay.

During diving trips with Luanna Pettay and William M. Stephens, we examined a partly burned log 3 feet long uncovered from under about 5 feet of sediment. The wood has been identified as Red Mulberry, *Morus rubra* Linnaeus. The position of the log was 38 feet under water and 6 feet back from the outermost stalactites of the overhanging cave roof. One end of the log was imbedded in the hard clay floor and the other end slanted upward at an angle of about 20° and just reached the demarcation between Layers 2 and 3. Human bones were found within a few inches of this log in the lower part of Layer 2 and the bottom of Layer 3. The intact surrounding sediment of hard packed leaves indicates this sediment had been undisturbed and that it is unlikely for the bones to have sunk down through the sediment to a position next to the log. However, it is not definitely established that the bones are of the same age as the burned log. A sample from this log sent to Scripps Institution of Oceanography produced a radiocarbon date of 8000 B.C. (10,000 ±200 years B.P., Sample No. L. J. 120, Hubbs, Bien, and Suess, in press). The data of Shepard and Suess (1956) indicating that the sea level 10,000 years ago was between 80 to 135 feet lower than present and the discussion of Curry (in press) indicating levels 100 to 150 feet lower further support the possibility that man could have lived in the limestone cavities now under water in Warm Mineral Springs. However, it has been generally suspected that man first came to Florida considerably earlier, and radiocarbon dates of 9020±350 B.P. from Russell Cave, Alabama (Miller 1958) and 7150±500 B.P. from the Eva site, western Tennessee (Lewis and Kneberg 1959) establish the existence of man in the Southeastern Archaic nearly 10,000 years ago. The oldest archaeological date previously reported for Florida is 6700±3300 B.P. based on an Ionium-Uranium age for marine shell gouge at the Bluffton site in Volusia County (Bullen and Sackett 1958).

Twenty feet to the left of the burned log in the lower portion of sediment Layer 2, an intact human skull (Fig. 2) was removed on July 11, 1959. Some white material was noticed inside the skull and some of this was removed by putting a finger in the foramen magnum. The material was soft and had all the appearances of a brain. It was brought to our laboratory where the remaining material was viewed through the foramen magnum by a practicing physician and three trained biologists, all of whom thought it looked like fresh brain tissue. The skull and contents were then immersed in formalin. The "brain" seemed to be rapidly disintegrating. It turned from white to dark gray in the next two days and the rounded convolutions became shrunken. Ilias Konstantinu, physician, sawed open the skull in his office in Sarasota. The remaining parts of the "brain" which had come apart were removed and the sediment washed off.

These fragments were examined by a number of medical doctors of the Sarasota Memorial Hospital staff who

Fig. 2 [Royal and Clark]. Human skull with preserved brain from Warm Mineral Springs, Florida.

FIG. 3 [Royal and Clark]. Fragment of the cerebrum of the soft brain found inside the skull in Figure 2. Length, about 4.8 cm.

agreed that the material had the form of a brain. Benjamin H. Sullivan, neuro-surgeon, stated that one piece appeared to be cerebellum and the other large pieces were obviously from the cerebrum (Fig. 3). From gross examination of a section through a cerebral fragment it was easy to differentiate the outer gray matter of fairly homogenous structure from the white matter which was fibrous in appearance. All the large recognizable fragments appeared to be mainly cortex. John S. Bracken, pathologist, made microscopic examinations of a stained histologic preparation but could find no cellular structure. Biochemist, Isadore Chamelin, ran a quantitative determination of a sample taken from the white matter of the cerebrum. The dried material weighing 11.7 mg. gave positive Salkowski and Lieberman-Burchard reactions. Quantitative determination of the substances present reacting with the Lieberman-Burchard reagent produced a value of 2 milligrams, equivalent to 17.08% cholesterol, esters and phytosterols, with an analytical error of ±5%. K. P. Oakley, British Museum (Natural History), after receiving a Kodachrome transparency and sample of the brain itself, wrote us that "one is left without any doubt whatever that the fragments in question are pieces of human brain." Oakley submitted the sample we sent him to G. C. Ross, in the laboratory of the Zoology Department, who reported the ashed weight of the original sample as 42.3% suggesting some mineral impregnation.

Instances of the preservation of the human brain for periods up to several millennia have been reported in the cases of Peruvian (Rivero 1857) and Egyptian (Smith 1902, 1911) mummies and cadavers recovered from peat bogs (Spatz, Kenk, and Diezel 1957). Thouret (in Spatz, Kenk, and Diezel 1957: 130) found brain tissue preserved in cadavers exhumed from a cemetery when the rest of the soft tissues were disintegrated. Oakley (1960) has reported a brain of Roman age preserved in adipocere. The brain from Warm Mineral Springs, however, appears to be the first instance known where preservation is believed to have taken place in water even though initially the brain may have been in a dry or damp environment. The preservation conceivably could have occurred due to some antibiotic activity of the sediment or spring water similar to the case described by Breder (1957) where the soft parts of a fish failed to decompose in aquarium water containing a population of *Pseudomonas eisenbergii* Migula.

The age of the brain may not be as great as that of the burned log and the human remains in Layer 3 on the cave floor because it was recovered from Layer 2.

Acknowledgments. We are grateful for the help and cooperation of the persons already mentioned and also the following: Al McFadyen of Warm Mineral Springs, Inc., encouraged this study and gave us permission to dive in the springs; Harold K. Brooks, geologist, University of Florida, confirmed the stalactite formations; William J. Clench, Museum of Comparative Zoology, Harvard University identified the molluscan shells; Carl L. Hubbs and H. E. Suess, Scripps Institute of Oceanography, arranged the radiocarbon dating of the burned log; B. Francis Kukachka of the U.S. Forest Service, identified the wood; Erdman West, botanist, University of Florida, identified the fern; Kenneth P. Oakley, British Museum (Natural History), Tilly Edinger, Museum of Comparative Zoology, Harvard University, and Harry L. Shapiro, American Museum of Natural History, gave helpful comments on this manuscript.

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CAPE HAZE MARINE LABORATORY
Placida, Fla.
March, 1960

REVIEWS

Edited by Donald Collier

No Stone Unturned: An Almanac of North American Prehistory. Louis A. Brennan. Random House, New York, 1959. xii+370 pp., 29 drawings, 12 pls., map. $5.00.

This book is so smoothly and entertainingly written that professors of anthropology may expect another period such as they experienced when a summary of American archaeology which contained excellent cartoons was published. They will find themselves devoting hours to explaining the mistakes contained in this volume, for many students will find this more entertaining and will read it with much greater gusto than the duller, but sounder, publications that are assigned to them.

Many of Brennan's conclusions will, as he has predicted, be received by archaeologists with "a snort like a cuckold bull walrus." The reviewer has no choice but to greet some of them with the tones of a deserted cow walrus. Others, however, are quite acceptable. In fact many of the statements which the author appears to feel are going to be regarded as entirely heretical would, with certain reservations, be accepted by a great number of archaeologists. There is, in some instances, a tendency to attack a virtually non-existent Dr. Phuddy Duddy who breaks into a rash at the mention of independent invention, who postulates a multitude of migrations from Asia, and who feels that he knows exactly when America was first inhabited.

Most archaeologists today are not entirely allergic to the thought of independent invention; they have largely abandoned the idea of a great number of movements from Asia, and in general they do not fix a date and say categorically that man in America cannot be older. What most are doing, however, is to demand adequate evidence before accepting claims for great antiquity. The majority of archaeologists would agree that the earliest American cultures now firmly established cannot be the earliest in fact and that they are the result of indigenous development. A good many have a strong belief that evidence of much earlier cultures will be found, although they do not feel that the evidence so far obtained is entirely convincing. Brennan, on the other hand, accepts at face value virtually all of the finds alleged to be of extreme antiquity and builds his highly imaginative theoretical structure on this base.

His general thesis is that, during the third interglacial, what he calls "Lewisville–Tule Springs–Santa Rosa Man" occupied the New World. He was not a Mongol or a Mongoloid. These two terms are used interchangeably. Some 15,000 years ago began the trifurcate period of population when there were three major groups of his descendants; the herd hunters, the usufructians who availed themselves of all possible resources both vegetal and animal, and the taigans who adapted themselves to the specialized environment of the taiga-tundra zone. With the coming of the Altithermal there was a commingling of these groups, the "Confluent period" began, and agriculture, based on the maize discovered by the Cochise, developed and advanced. Pottery making, which resulted from the practice of covering coiled withes of grass with clay, and the building of earthworks, resulted from a Mesoamerican stimulus.

The Hopewellians were a New York group that moved westward and invaded the territory of the Adena people. They coexisted without intermingling for a long period of time, but there was conflict and intermittent warfare between them. Eventually there was some intermarriage, but both groups declined and slipped back into a usufruction way of life modified only by the presence of maize and tobacco. Some of the Hopewellians of higher caste may have reached New York and contributed to the development of the Iroquois Confederacy.

Among the most dramatic sections is the one in which Brennan proposes the theory that it was the Llano people, the makers of Clovis points, who became the Solutreans of western Europe. The theory that the Solutrean is a Europeanized Llano man, he feels, provides "the perfect answer to everything except how Llano man got to the Loire." This would appear to be one of several fairly major considerations. The proposed solution features a lost Atlantis now represented by a submerged ridge in mid-Atlantic. The author does state, however, that "to say that the mid-Atlantic ridge is proved, and that all that we have outlined in the foregoing necessarily follows, would be flagrant quackery." It would indeed.

The remarkable Llano people, however, came to a sad end if the author is correct in his interpretation of the appearance of the fluted points of the eastern United States. He feels that they look "like the points of a driven, outcast people who are about to peter out." Rarely have stone implements yielded so much information.

There are numerous sections of this book that can be most heartily recommended to archaeologists who suffer from low blood pressure. They should have real therapeutic value. Those with a tendency toward hypertension should approach them with caution.

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Centre d'Analyse Documentaire pour l'Archéologie. J. C. Gardin. Centre National de la Recherche Scientifique, Paris, 1959. 35 pp., 10 figs., 1 table.

This attractive brochure describes the work of the Centre d'Analyse Documentaire pour l'Archéologie. The purpose of this center is to organize and make easily available archaeological data that are scattered through a wide variety of literature, and thus, to reduce duplication of effort on the part of research scholars.

After considerable experimentation the collaborators, of whom Gardin is deputy in charge of research, developed a system by which information is coded and punched on cards that are then quickly and easily sorted by viewing their alignments against an ordinary light. The punching and duplicating machines at the Center are the only equipment needed, beyond storage space for the files. The process is simple, and is designed to keep the cost low and thus permit wide distribution.

The construction of such an analytic catalogue requires a careful selection of criteria to be coded, a standardization of terminology, and the reduction of fundamental types to combinations of particular trait descriptions. Although the number of traits coded may be modest, their variations make for innumerable possible combinations. The critical points would seem to lie first in the choice of data and in the construction of a simple, comprehensive, and usable code for each class of objects, and secondly in the accuracy and caliber of the interpretation, editing, and code assignments of each object.

These perforated cards constitute an index to a second card catalogue which contains the descriptive data. Correspondence between the two sets is by number. Thus one can search for a specific character, readily locate the objects which have it, and find additional information on the descriptive cards. Furthermore, since the bibliographical references are included, one can refer easily to the original descriptions.

At the time of writing, the status of the Center's present operations by category was as follows:

1. Weapons and tools. Code established. For the metal tools of the Bronze Age from the Balkans to the Indus, code, inventory, and card file established.

2. Pottery. Ceramics of the Early and Middle Bronze Age of the Middle East: code established, sample card file.

3. Iconography. a) Cretan money of the Classical period: code, inventory and file established. b) Cylinder seals: code established, inventory and analysis under way, sample card file. c) Greek painted vases: code under way, sample card file.

4. Texts. a) Clay tablets: code established, inventory under way, sample card file. b) Conceptual analysis of the Koran: code established, analysis and card file both under way.

The work of the Center looks promising. The labor, however, is enormous, and whether it is worth while depends upon the adequacy of the coded data. In the meantime it deserves careful attention, for American archaeologists could certainly adapt the system to fit their needs if it proves itself in actual use. A visit to the Center should be of interest to any American archaeologist who finds himself in Paris. It is located in the Pavillon de Flore, Palais de Louvre.

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Pre-Columbian Cultural Connections between Mesoamerica and Ecuador. Stephan F. de Borhegyi. Middle American Research Records, Vol. 2, No. 6 (preprinted from Middle American Research Institute, Publication 18, pp. 141–56), Tulane University, New Orleans, 1959. 15 pp., 2 figs.

The conclusion of this paper — that there is a long history of connections between Mesoamerica and Ecuador, intensified during Late Classic times — is beyond reasonable dispute. The fact that the evidence presented by Borhegyi is not completely convincing is partly attributable to the unpublished nature of most of the recent evidence, particularly the work of Emilio Estrada. It is also, however, partly due to the kinds of traits selected in support of connections.

A list of 67 features found in both areas comprises half of the paper. These are grouped into a number of major categories, including settlement patterns, ceramics, figurines, stonework, metallurgy, and miscellaneous traits. Some are specific and unique elements, which, being virtually restricted to Mesoamerica and Ecuador, argue strongly for direct connections. Among these are napkin-ring earplugs, mammiform vessel feet, "figurines tied to bed," pottery masks, and three-pronged incense burners. The majority, however, are generalized and occur on such a broad scale that they are meaningless for establishing specific areal connections. Traits of this type include maize agriculture, use of funerary urns, biconical drilling, face-neck jars, shoe-shaped vessels, striated pottery, and fine-line incised decoration on pottery. All of these are so common in South America, especially throughout the Andean area, that their presence in Ecuador is no more indicative of Ecuador-Mesoamerican contacts than their presence in Argentina is of Argentine-Mesoamerican connections. Borhegyi recognizes this (p. 146).

The latter portion of the article and the illustrations deal with one of the unique parallels, the three-pronged incense burner. A relatively common feature from Highland Maya sites, it had not been recognized from Ecuador until recently. Ecuadorian examples are restricted to the north coast and appear to come from a relatively late period. All of the other unique parallel traits except for the napkin-ring earplugs (which are of Formative age) come from the same area and time horizon. These clearly support Borhegyi's thesis that direct sea connections existed between the two areas in the Late Classic period.

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La Religión en el Antiguo Perú. (Norte y Centro de la Costa, Periodo Post-Clásico.) Rebeca Carrión Cachot de Girard. Tipografía Peruana, Lima, 1959. 150 pp., 123 figs., 5 pls.

The author of this monograph is a former Director of the Museo Nacional de Antropología y Arqueología of Lima. She was working on the book in 1954, while she

was still Director. The study is based in part on archaeological specimens in the Museo Nacional and other museums and private collections in Lima, Trujillo, and Lambayeque, and in part on collections in European museums which she visited in 1952. The monograph includes 123 figures and 5 plates consisting of very good drawings, most of them of pottery designs, which were made by Cirilo Huapaya Manco and Pedro Rojas Ponce of the staff of the Museo Nacional.

The text is a series of speculations about the religious significance of pottery designs. The speculations are not sufficiently well founded to be useful for their purpose, and there is no evidence of associations which could be used for archaeological reconstructions. However, the illustrations of pottery designs are very helpful and interesting, and the author makes some good observations on the designs, mainly in pointing to the various animal, plant, and human figures which are shown in special patterns of association. The illustrations are particularly good in showing the contours of the panels in which the designs are contained, and in including small shape drawings of the respective vessels with many of the design illustrations, both features which provide useful associations.

As Carrión points out, very few illustrations of vessels of this type have been published previously because pressed ware is not particularly appreciated by modern collectors. Most of it is from the general area of the north-central coast between Ancón and Casma, but some of the specimens, notably modeled representations of anthropomorphized corn figures and ring-based spouted bottles (Figs. 82, 83, Pls. I–III) apparently originate farther north on the coast. Shape and design features indicate that the pottery belongs to the Middle Horizon, corresponding in time to Epochs 2 or 3 in terms of the south coast chronology, that is, in part contemporary with the flourishing of the Tiahuanacoid centers of Pachacamac and Huari and in part probably of slightly later date.

Ernesto E. Tabío, who has made extensive surface surveys on the north-central coast, particularly in the Huarmey valley, reports that pressed ware with representational designs showing ceremonial and symbolic scenes forms a relatively large proportion of the pottery in surface collections, and sites with pottery of this period are much more abundant than those of almost any other time. In view of the relative scarcity of pottery of this period in most other areas in Peru except for a few special centers, the abundance of pottery with ceremonial Tiahuanacoid designs on the north-central coast is surprising and suggests that this area was an important provincial center of Tiahuanacoid symbolism at a time only slightly later than the first flourishing of Pachacamac. While the designs indicate that Pachacamac-Tiahuanacoid motives furnished the primary source of inspiration, there is also a strong element of themes derived from the Moche tradition, and some, such as paired profile felines, which suggest designs of the Callejón de Huaylas. Mass production of ceremonial themes in pottery and textiles became a characteristic of Tiahuanacoid ceremonial centers in Middle Horizon Epoch 2 at Nazca, Huari, and Pachacamac, but nowhere to the extent of the mass produced pottery on the north-central coast, where the introduction of molding techniques of north coast origin for making both vessel bodies and designs apparently lent a special impetus to this development.

The excellent illustrations of Carrión's book thus provide a very useful guide to future studies of what appears to be an important secondary center of development of the Tiahuanacoid and Moche traditions, apparently in part at a time when these traditions had lost their force in most other regions. Not of least interest among the scenes shown in the illustrations are several which show representations of wooden objects generally referred to as "oars" or "paddles" in the literature. Max Uhle was the first to suggest that these objects were actually tools used in agricultural work. Uhle's observations are supported by eight illustrations in Carrión's book which show symbolic figures representing various anthropomorphized plants or surrounded by plants, holding a "paddle" in one hand, and a digging stick, plant, "paddle" or other object in the other, in an unmistakable representation of agricultural pursuits (Figs. 41–45).

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Paracas: Primera Parte. Julio C. Tello. Edited by Toribio Mejía Xesspe. (Project 8b of the 1941–42 Program of the Institute of Andean Research, New York.) Museo Nacional de Antropología y Arqueología, Lima, 1959. iv+72 pp., 143 figs., 94 color pls., 3 maps. $20.00.

The first volume of Tello's *magnum opus* is in quarto format; there are some 950 words per page and an abundance of illustrations. The task of editing this posthumous work must have been tremendous, hence little criticism should be made of occasional errors in plate references and figure numberings. Rather, Mejía Xesspe should be thanked for what he has accomplished in making the work available. No one familiar with Tello, his archaeological methods, and his previous publications will expect the present one to conform to the standards of contemporary scientific archaeology. Yet if Max Uhle was "the father of Peruvian archaeology," certainly Julio C. Tello was in fact and function its most devoted son.

There is always a difficulty in reviewing one volume of a work which may later extend to two or more. In the present case the problem is heightened by a disjunction between the text and the illustrations. While the latter show Paracas and Nazca ceramics and the infinite variety of textile ornament, they only in small part elucidate Tello's opinions as expressed herein. Consequently this review will first summarize the text and then the illustrations, using Tello's terminology throughout.

The book consists of an introduction and three chapters. The Introduction previews the contents of the remainder of this volume. The most important subjects are: a brief collation of Uhle's, Kroeber's, and Tello's Nazca-to-Inca time sequences, the southern coast or in-

land sites relevant to Tello's views, and an outline of his culture and sub-culture sequences for the south coast. The full exposition of these points, especially the last two, are made in Chapter III.

Chapter I explains the natural setting of Andean archaeology in terms of the three topographic strips, their climates and products. There is a reconstructed picture of the ancient life of the inhabitants of coast, highland, and montaña, their exploitation of natural products, and their inter-regional trade. Beneath the facts, familiar to all Peruvianists, is a sombre theme: the psychological relationship of humans to their environment in the quest for survival in an awesome world which jeopardizes agricultural and pastoral pursuits. (This is the covert link with the unexplained "calendric" features of Paracas art shown in the illustrations.) Here appears Map 1, a large tip-in of watersheds and archaeological sites in the central and south coast and highland germane to Tello's discussion. All references to the north coast and highland (with the exception of Chavín, of course) are omitted.

Chapter II reviews chronologically the history of Peruvian archaeology. While each studious excavation of importance is mentioned, attention is focussed on the author's own activities. The founding of the Museo Nacional under Max Uhle's direction, the development of the Museo de Antropología y Arqueología, the subsequent impact of the Paracas discoveries, and the role of the Institute of Andean Research are the major subjects of this long chapter. While much of this, too, is familiar material, tucked into Tello's recapitulation of his own explorations are facts or opinions which must be collated with others in all sections of the book, for example, the "tropical" source of his Chanka culture (compare pp. 26, 50, 61).

Chapter III concerns the relations of Paracas culture with others of the central Andean region. In the immediate Paracas-Pisco area Tello recognizes three cultures: the earliest Chavín-derived Cavernas, evolving into the Necropolis stage, and a localized version of his Chincha (late, pre-Inca) period. The defining cultural ingredients of each are described at length (pp. 53–8). The remaining text is devoted to summaries of all the cultures or sub-cultures composing the south coast sequences as formulated by Tello from the results of his own excavations. These are Paracas, Nazca, Chanka (with montaña ingredients), Wari, Chukurpu and Rukana (all highland derivatives), and Chincha. The components characteristic of each are set forth in an orderly, detailed fashion, but range unequally through such criteria as burial methods, physical types and head deformation, structures, ceramics, textiles, plants, animals, and other miscellany. An analysis of their significance in contemporary terms is a task each Peruvianist will have to make for himself; as categorically grouped they do not align with the period-area definitions generally accepted today.

Of first interest in the color plates are several vessels known previously through half-tone publication. The total number of plates devoted to pottery is relatively small (ten Cavernas, two Necropolis, eight Nazca, three Chanka, and two Pre-Rukana). The 143 black and white figures illustrate Paracas and Nazca pottery, Ocucaje gourds, and many elements of Paracas, Nazca, and Chanka mythological creatures.

Necropolis textiles receive preponderant attention. The contents of one bale are revealed in successive layers from outer wrappings to final mummy basket in Plates XI to XXVI. The figures embroidered on each of its mantles are pictured in 26 following plates. It is noteworthy that all figures, when repeated on a mantle, are identical except for the face and eye treatment (compare Pls. XVIII–XXXI or XXXVI–XL). The permutations of color schemes in such figures appear to be purely decorative, suggesting that it was the face or mask which was of signal import. Another bale is similarly displayed in Plates LV–LXVI. A group of painted figures on one cloth specimen are exhibited in ten other plates. The multitude of such illustrations combined with those in the black and white series are of great value for seriational design analysis and for both intra- and extra-Paracas comparisons. For example, the guilloche motifs shown here on Cavernas pottery and Ocucaje gourds are also known in Chavinoid gold work, Salinar pottery, and a Yauca textile. Precise and evanescent, these ornaments, rendered in several media during an early era, by their rapid exit from later Peruvian art become useful diagnostic traits.

In the color plates the impact of the mythological figures is tremendous. Here the flat hues, without the embroidery stitches indicated, convey more of their original significance and perhaps explain the oft-remarked monotony of Paracas stitchery. Seemingly the aim was not so much textile virtuosity as visual communication, for which the flat stemstitch is the perfect medium. The minor distinctions of faces in what are otherwise the same figures indicate the intensity of meaning which these motifs had for their viewers.

The Paracas designs are an expression of an extraordinary imaginative vitality. As an art form the motifs suggest a style which has reached its apogee; grounded in a formulated pantheon, the visual renderings have exploited to the point of exhaustion writhing lines, primary and subordinate ornamental details, and color permutations. Yet they remain lucid. Presumably the Necropolis curvilinear style gave way to the complexities of an aggressive artistic style in Nazca ceramics wherein fundamental meanings were gradually submerged by exuberant decorative trifles. Little wonder that filiated late Nazcan ceramic motifs became a mere jumble of revenant design elements.

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Archäologische Studien in den Kordilleren Boliviens. Hermann Trimborn. Baessler-Archiv, neue Folge, Beiheft 2. Dietrich Reimer Verlag, Berlin, 1959. 76 pp., 66 figs. DM 12.

Trimborn traveled in Bolivia in 1956 and visited a number of archaeological sites. This publication presents the notes he took on surface remains, with additional in-

formation compiled from the literature. No excavations are reported. The title is to be taken literally; the work consists of a series of unrelated studies strung together for convenience of publication, without introduction or conclusion.

The text consists of three numbered sections. Section I is a miscellany without a separate title. It consists of some comments on Tiahuanaco, a discussion of the well known "Horca del Inca" at Copacabana, an account of the ruin of Incaracay near Sipe-Sipe, a description of the "Piedra Pintada," a petroglyph site near Tarija, and comments on a number of individual specimens from Bolivia, including 13 from the Ethnographic Collection of the University of Bonn and two from the author's own collection. Section II is entitled "The Chullpas of Sica-Sica" and describes a group of adobe tombs in the province of Aroma, with comparative notes on other chullpas in central Bolivia. Section III is entitled "The sculptured hill near Samaipata." It describes the elaborate rock carvings on a prominent hill near Samaypata on the road between Cochabamba and Santa Cruz. Trimborn utilizes earlier descriptions by Orbigny, Nordenskiöld, and Pucher as well as his own notes. At the end, as a kind of appendix, is a brief summary, half a page long, of the field work done by H. D. Disselhoff and H. Walter in Bolivia in 1958.

The "Horca del Inca" and the "Piedra Pintada" are undatable. The chullpas illustrated probably date to the Late Intermediate Period, although some of them may have been built after the Inca conquest. Trimborn illustrates four sherds from the chullpa site at Sica-Sica belonging to a local style. Incaracay and Samaypata are clearly Inca sites, the former because of its architectural style, the latter because of the associated artifacts. The pottery illustrated (18 specimens with regional provenience but no published associations) represents varieties of the Tiahuanaco style and other local styles which are probably later. The discussion of these specimens contributes nothing to the problem of dating and very little to that of defining local styles. Furthermore, many of the photographs are reproduced so poorly that the details of the designs cannot be made out. On the whole, this collection of studies is a useful, though modest, contribution to Bolivian archaeology.

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A Jazida José Vieira: Um Sitio Guaraní e Pre-Cerâmico do Interior do Paraná. Annette Laming and Jose Emperaire. Universidade do Paraná, Departmento de Antropologia, Comunicações Avulsas, No. 1, Curitiba, 1959. iv+143 pp., 40 figs.

In 1954 the National Research Council of Brazil established an archaeological section within the Department of Anthropology of the University of Paraná in Curitiba. Results from research conducted under this organization now appear in monograph form as the first in a new series of anthropological publications of the University. In an effort to expand the facilities of the Research Center, the new monograph is not being sold but offered on a gratis and exchange basis. Archaeologists interested in South America should take advantage of the offer by writing to the Department of Anthropology, Universidade do Paraná, Rua General Carneiro, 460 — 6° Andar, Curitiba, Paraná, Brasil.

The French archaeologists, Annette Laming Emperaire and Joseph Emperaire, conducted archaeological excavations for several years in Brazil. This monograph describes their 1957 excavations and the artifacts with their interpretations of the cultures at the site of José Vieira on the left bank of the Rio Ivaí in the State of Paraná, 20 km. from Cidade Gaucha in the lower reaches of the drainage before it flows into the Rio Paraná. On top of a 15-meter bank black layers of sand contained habitation refuse. Two large stratigraphic excavations were made, each measuring 5 by 5 m. These excavations revealed the following distinct layers: Layer I, humus from the surface to 50 cm.; Layer II, blackish-brown sand with pottery and stone scrapers and chopping tools, from 0.50–1.30 m.; Layer III, a layer of lighter sand from 1.20–2.30 m. with stone artifacts and a few sherds found only from 1.30–1.60 m.; and Layer IV, intermittent layers of sand and silt from 2.30–2.90 m. with only percussion-made stone artifacts. In 1957, the base of Layer IV was never reached due to the rising waters of the Rio Ivaí; however, an insert in the publication, dated October, 1959, states that in September, 1959 new excavations were undertaken at the site at which time materials for radiocarbon dating were collected and the sterile base of the deposit was reached at a depth of 4.50 m.

Analysis of the sediments lead the authors to the conclusion that the lower levels, Layers III and IV, are the result of habitation refuse mixed with fluvial sediments from the flooding of the Rio Ivaí, while the upper levels, Layers I and II, are from deposition by wind, followed by the growth of tropical forests that they claim took at least 500 years. Although the point of the length of time required to develop forest growth in a tropical forest situation is open to an alternative viewpoint, which the authors do not recognize, it figures heavily in their discussion of determining the age of the pottery-bearing deposits.

The second part of the monograph describes the archaeological evidence, the burials, the pottery, and the stone artifacts. The descriptive sections and line drawings of both pottery and stone are very good, and it is possible to get an excellent idea of the artifact complex. The artifacts separate into two distinct cultural complexes, the upper layers with pottery and the lower layers with stone artifacts. The pottery represents the Guaraní occupation of the site. The burials of two women and a child from Layer II also belong to this complex. Pottery is represented by 485 sherds, all from Layer II, except for three undecorated sherds from the first 15 cm. of Layer III and 1 sherd from the following 15 cm. of the same layer. All these sherds are typical of the known Guaraní materials from the Paraná basin with painted geometric

patterns in red or brown on white slip and fingertip-, fingernail-, or stick-impressed, unslipped ware. After extensive discussions to demonstrate that the associated complex of various pottery types from José Vieira site are the same as that found in known Guaraní sites of Brazil and nearby Paraguay, the authors then proceed into some speculations that do not seem to be substantiated by their evidence nor to follow their previous reasoning. They argue that the Guaraní did not come from the coast because no such pottery has come from any of the shell mounds in Brazil or Uruguay or Argentina, and that the Guaraní did not develop locally but moved into the area. From this point on (pp. 79–81, including footnotes) the authors present a weak case, and a poor handling of comparative literature, on the origin and age of the Guaraní culture. They offer no conclusive evidence for their idea of an Andean origin, nor for their guess dates of A.D. 200 to 800.

The pre-ceramic complex consists of stone tools all made by percussion flaking of water-worn, rounded pebbles, except one polished small chisel from Layer II. The crude tools are cores or flakes and consist of choppers, hammerstone-choppers, bifaced scrapers or knives, with each type well described and illustrated and with tables to show the frequency of each type per layer. Although all the stone artifact types continue throughout the four layers, the bifacial tools increase in quality and quantity toward the bottom of the stratigraphic excavation in Layers III and IV, indicating that the first occupants of the site had a better stone working technique than the more recent Guaraní culture. The authors suggest an independent evolution of the preceramic stone industries of Paraná from those of the shell middens of the Brazilian and Uruguayan coast. No estimate of age of the Paraná preceramic complex is given. The volume concludes with a short summary in French, English and German; the original text in French was translated into Portuguese by Jamile Cury.

In spite of the weak comparative sections and the speculations on the origin of the Guaraní that the data do not seem to support, the monograph is a basic scientific contribution and a step forward in the archaeology of Brazil because the Paraná region has been sadly neglected in the past. Unfortunately, Jose Emperaire died recently in Argentine while conducting stratigraphic excavations, but it is hoped that his widow, Annette Laming, will continue their work in Brazil and there will be many archaeological numbers in the new series of the Universidade do Paraná.

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Ancient Mexico. FREDERICK A. PETERSON. G. P. Putnam's Sons, New York, 1959. 313 pp., 93 figs., 24 pls., 6 maps, 8 tables. $7.95.

In contrast to the majority of popular treatments of prehispanic Mesoamerica, which largely limit their coverage to either the Maya region (for example, the recent syntheses of Brainerd, Morley-Brainerd, and Thompson) or central-southern Mexico (for example, the general accounts of Vaillant, Burland, Soustelle, Krickeberg, Van Giffen-Duyvis, Von Hagen, and Bernal), this book attempts to cover most of Mesoamerica, thus ostensibly resembling in the breadth of its aim such works as *México Prehispánico*, Covarrubias' recent art history, and *Esplendor del México Antiguo*. Analysis reveals, however, that much of the text is devoted to late Postclassic central Mexican ("Aztec") culture. The treatment of the Maya is very general and incomplete, while the other leading Mesoamerican traditions receive varying amounts of brief attention.

The first five chapters consist of a compact resumé of over-all Mesoamerican culture history. Peterson generally follows the accepted sequence, although he employs some novel terms: "First Farmers," "Magicians," and "First Architects and Priests" for the Early, Middle, and Late Preclassic; the Classic is divided into four sub-periods: "Transitional," "Classic," "Baroque," and "Terminal," while "Historic" is preferred to Postclassic. Up to page 47, the discussion is largely confined to the Valley of Mexico; at this point the Preclassic sequences of Chupícuaro, Pánuco, Yucatán, Petén, Monte Albán, Remojadas, and Chiapa de Corzo are cursorily described. Although recognizing that the recent Heizer-Drucker La Venta radiocarbon dates support the Preclassic position of La Venta-Olmec, he places his brief description of this phase in the fourth chapter, which is devoted to the Classic, and almost entirely confines it to an account of the La Venta site (San Lorenzo is not mentioned; both this site and Tres Zapotes are omitted from the general site map.) The most striking omission (for all periods) is highland Guatemala, which apparently was excluded because it lies outside the boundaries of modern Mexico. However, the Guatemalan Petén enters into the coverage, which highlights the complete lack of even brief reference (apart from the inclusion in the bibliography of the Carnegie Kaminaljuyú report) to the important southern Maya area.

After a brief introduction, the treatment of the Classic is essentially confined to capsule descriptions of Monte Albán, Xochicalco, La Venta, Pánuco and western Mexico in general, Teotihuacán, Cholula, and Palenque. The Classic site descriptions might have been made more meaningful for the average reader by the inclusion of some small site plans or at least more architectural illustrations (only those old perennials, the Quetzalcoatl and Sun pyramids at Teotihuacán, the Great Pyramid of Cholula, and the Pyramid of the Niches at Tajín are illustrated). The treatment of the Early Postclasssic is essentially confined to a tracing (following almost literally the Jiménez Moreno reconstruction) of Toltec political history and a brief discussion of Tula–Chichén Itzá archaeology, although political-cultural events in Oaxaca and northern Yucatán also receive some attention.

In Chapter 5, the Aztec-Mexica migration from the north is narrated, and considerable space is devoted to their turbulent early political history up to the Tepanec War (1428). The subsequent course of Triple Alliance

imperialism is sketched, aided by re-publication (p. 100) of Barlow's (1947) map of the Aztec conquests. The remaining chapters are more ethnographic in slant, ranging broadly over such topics as education, political organization, justice, religion, militarism, cultivated plants, diet, commerce, calendrics, music-song-dance, costume, writing and painting, ceramics, arts and crafts, and architecture. Special attention is paid to Aztec culture, particularly in the discussion of the first few topics mentioned; however, some topics, usually considered important to a rounded understanding of this culture, are omitted or only cursorily treated, for example, agricultural techniques, structure of the empire, literature, and life cycle.

Peterson's account of Tenochca socio–political structure presents a much more accurate picture than Vaillant's Bandelier-dominated account which for so long has exerted such a distorting influence. However, some of his declarations and terminology (for example, "warrior caste") must be accepted with reserve, while there are some significant omissions, such as his insufficient recognition of the importance of the Cihuacoatl in the Tenochca political power structure. In the chapter on religion, cosmogony and mythology are entirely omitted, and ritualism, the intense elaboration of which was a particular Mesoamerican diagnostic, is discussed in only the broadest terms. Although incomplete and containing a few dubious statements, the list (pp. 131–6) of the lesser deities of the Aztec pantheon is very useful, as is the shorter list (pp. 138–9) of principal Yucatecan Maya supernaturals. Although Mayanists may question some details, the material on calendrics, while brief, seems generally adequate; however, his adoption of the Caso scheme of the Mexica *xihuitl* (p. 192), still not universally accepted, might have been made more explicit. The discussion of Mesoamerican writing is so general that many readers will probably remain almost completely in the dark as to the specific mechanics of either the Aztec or Maya systems. His brief list of putatively prehispanic codices (pp. 237–8) is useful, although I would continue to object to the use of the label "Mixtec" for those of the so-called "Borgia Group." The section of the book devoted specifically to esthetic matters suffers somewhat from a diffuseness of coverage which may make it difficult for the general reader to form a very coherent picture of any one of the great Mesoamerican stylistic traditions. Noteworthy is the almost complete absence of discussion of three of the most brilliant of the Mesoamerican arts: woodcarving, precious-stone mosaic, and feather-working.

Finally, a very general Mesoamerican sequence chart is presented, including only the major phases of the Central Highland, Gulf Coast, Oaxaca, and the Maya region, plus a highly selected bibliography of 105 items. The latter contains only one title (1957) after 1955. Some striking omissions are observable, of which the Dibble and Anderson English translation of Sahagún's *Florentine Codex* is perhaps the most noteworthy.

It is hardly surprising that in a book so wide in its coverage there are a number of minor errors of fact and items of interpretation which might be challenged. It is regrettable that the number of typographical errors in the spelling of Nahuatl names is excessive, certainly an unnecessary though common failing in popular books on ancient Mexico.

Ancient Mexico is entirely undocumented and is obviously slanted at a very wide layman audience, that is, it is considerably more "popular" than, say, Vaillant's *Aztecs of Mexico*, Soustelle's *Le Vie Quotidienne des Azteques*, or Krickeberg's *Altmexikanische Kulturen*, books it otherwise somewhat resembles in aim. It constitutes a very general, readable, and up-to-date introduction, essentially accurate in broad outline, to a number of aspects of prehispanic Mesoamerica. More advanced students will find its good photographs and the excellent line drawings of José Luis Franco, both often of pieces never before illustrated, of value, in addition to an important hitherto unpublished map by Jiménez Moreno (p. 74) of the "tiny empires" which flourished in the Valley of Mexico (about 1350) just before the sudden rise of the Tepanec Empire, the direct ancestor to the imperial order found in central Mexico by Cortés.

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Research in Chiapas, Mexico: 1. *The Chiapas Project, 1955–1958, Report of the Field Director*. Gareth W. Lowe; 2. *Archeological Exploration of the Upper Grijalva River, Chiapas, Mexico*. Gareth W. Lowe; 3. *Explorations at San Agustin, Chiapas, Mexico*. Carlos Navarrete; 4. *A Brief Reconnaissance in the Region of Tonolá, Chiapas, Mexico*. Carlos Navarette. Papers of the New World Archaeological Foundation, Nos. 1–4, Publication No. 3, Orinda, California, 1959. iv; vi+21 pp., 12 figs.; vii+112 pp., 64 figs., 4 tables; iii+16 pp., 10 figs.; iii+10 pp., 8 figs. $4.00.

Ceramics from Two Preclassic Periods at Chiapa de Corzo, Chiapas, Mexico. Keith A. Dixon. Papers of the New World Archaeological Foundation, No. 5, Publication No. 4, Orinda, California, 1959. vii+52 pp., 55 figs., 2 tables. $2.00.

The New World Archaeological Foundation is a unique organization. It was founded in 1951 by T. S. Ferguson, of Orinda, California, with the cooperation of A. V. Kidder, G. R. Willey, and others. Ferguson is a Mormon who believes that a broadly conceived and professionally staffed program of archaeological research in one of the less-known parts of Mesoamerica would aid our understanding of the origin of the New World civilizations. As J. Alden Mason, the editor of this series, points out, the Book of Mormon describes three separate migrations from the Near East to the New World, and many Mormons have therefore been interested in comparing descriptions from the Book of Mormon with the ethnological and archaeological data from various parts of the New World. However, the Mormon Church has never made any official statements or claims regarding such comparisons. According to Mason, the stated purpose of the New World Archaeological Foundation is

"not to seek corroboration of the Book of Mormon account, but to help resolve the problem of whether civilization in Middle America developed autochthonously or as a result of diffused or migrated influence from some area of the Old World, and to shed light on the culture and way of life of the ancients during the formative period." There is every indication that the Foundation's work is proceeding on a highly professional level and that its results will fully justify the hopes of its sponsors. The reports under review are the first of a considerable series now in preparation which will make available in the fullest possible detail the field work thus far completed. The Foundation has been supported by private donations and by a grant from the Church of Jesus Christ of Latter-day Saints. The excellence of these first major reports and the importance of the area investigated make this a program of great significance for Middle American archaeology.

The Central Depression of Chiapas, in which the Foundation's work is centered, extends southeast for about 250 km. from near the Oaxaca border to the boundary of Guatemala, and is drained by the Grijalva River. It was chosen because of its significant location between major centers of Mesoamerican culture and because it had had relatively little previous archaeological attention. The scope and sequence of the program's activities from 1955 through 1958 are described by Lowe in Paper No. 1. Two short papers by Navarette, Nos. 3 and 4, describe two of the many separate brief surveys and excavations of the program; it can be assumed that other similar brief but detailed reports will be forthcoming on other sites and sub-regions. Lowe's longer report, Paper No. 2, reviews the survey of nearly 100 sites that formed the basis for all subsequent work on the Upper Grijalva; he summarizes the culture history from early Formative through late Postclassic, and indicates the role this area has played in relation to other parts of Mesoamerica. The second long paper, by Dixon, will be of immediate interest to all those now working on the Formative, because he describes in detail the pottery from two early levels of Chiapa de Corzo, a major site which the Foundation has spent several seasons excavating.

Details of these five reports can only be sketched here in order to suggest the nature and results of the Foundation's work thus far. The Central Depression of Chiapas, one of the drier parts of Central America, appears to have supported from early Formative times a somewhat conservative population who influenced their neighbors very little. The area served as a buffer zone and a route of contact but failed to develop to a significant degree such familiar Mesoamerican traits as masonry temples, carved stelae, and tombs. Nevertheless, a very long and interesting sequence of local cultural developments has been worked out by Lowe and his colleagues, adding especially to the picture of the Formative that is emerging so rapidly from work in many parts of Mesoamerica. Numerous ceremonial centers have been mapped and a few tested by digging, and a sequence of architecture and of site plans can be reported (Figs. 3–8, 34). Few sites show a long occupation, although the area was continuously inhabited for at least 3000 years and sites have been found for each of six successive (as yet, unnamed) phases. Abundant illustrations of pottery in Lowe's paper will be of interest to specialists, but they are arranged by site or region and do not provide a systematic review of the ceramic history of the area. This will presumably be undertaken in future publications in the series. The relationships of the Upper Grijalva area with near and distant parts of Mesoamerica are suggested in the varied pottery styles — connections with the Petén in Formative times and with El Salvador in the Protoclassic, with the Valley of Mexico and the Gulf Coast in the Early Classic, with the Usamacinta-Palenque region in the Late Classic, and with adjacent Oaxaca in the Postclassic. Evidence has not been found to support theories of close relationships with the Chorotegan areas of Costa Rica and Nicaragua.

Navarette's excavations at San Agustin were in a single important structure, a plaster-faced pyramid containing the tomb of an important personage who was accompanied by a group of pottery vessels, jade ornaments, and the remains of a second, seated, individual. The tomb is Late Preclassic and the pottery has similarities to that of the Chicanel phase of Uaxactún.

Reconnaissance near Tonalá on the Pacific coastal plain is reported in Paper No. 4. Collections were made at three sites, all of them indicating the need for further work in this area.

Excavations at Chiapa de Corzo were begun in 1955 and continued through the 1958 season, revealing an extensive complex of structures with a long occupation. Dixon's report, Paper No. 5, outlines a long-range program for the reporting of the tremendous amount of pottery excavated, extending from Formative through late Postclassic. As an initial step of this reporting, he presents details of two important samples of material, unmixed deposits from the two earliest phases of the site. The earlier sample, termed the "Pit 50" material (Chiapa I of a 1957 preliminary report), has a radiocarbon date of 1052 B.C. ± 100 and includes white-slipped monochrome (flat-bottomed bowls with vertical or flaring sides, vertical-necked globular jars), red-and-white bichrome (flaring-walled bowls), and unslipped neckless jars; 8 sherds have rocker stamping. The second sample, termed the "Pit 38" material, has three radiocarbon dates from the same sample from the bottom of the deposit ranging from 900 to 800 B.C. and includes most of the ceramic traits of the preceding sample, but with an increase in incised decoration. Dixon does not propose type names nor a sequence of named or numbered phases into which these samples fit; this is postponed for later reports, following the description of more groups of homogeneous or single-phase sherds. He briefly evaluates the importance of these two samples, as the representatives of yet another regionally distinctive ceramic complex of the Mesoamerican Formative. Resemblances are noted to La Venta, Lower and Middle Tres Zapotes, Tlatilco, Mamom or early Chicanel, the Playa de los Muertos Preclassic, and Miraflores, yet none of these assemblages matches closely the Chiapa de Corzo material.

Mention should be made of Publications No. 1 and 2 of the New World Archaeological Foundation, since these new publications are a continuation of them in a numerical sense only. The previous format has been abandoned and the present papers set a high standard of presentation. It would have been helpful, however, if a few more references could have been included to some of the previously published interpretations, such as the Chiapa I–VI ceramic sequence, with either corroboration or corrections. And in future papers of the series a more systematic arangement of illustrations should be possible — in Lowe's longer paper the artifacts are grouped by minor subregions rather than by the major temporal phases, and pictures of personnel, landscapes, ruins, and artifacts are rather haphazardly combined.

In spite of these minor flaws the field workers, writers, and editor of the New World Archaeological Foundation deserve to be congratulated on these initial publications of what should be an extremely important series. Central Chiapas does not prove to be a major cultural hearth, but the establishment of a long and detailed cultural sequence in this previously little-known region is a substantial addition to our knowledge of the Formative era, that crucial period of regional differentiation and growth for the major New World civilizations. Future publications in this series will be eagerly awaited.

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Excavations at La Venta, Tabasco, 1955. Philip Drucker, Robert F. Heizer, and Robert J. Squier. Bureau of American Ethnology, Bulletin 170, Washington, 1959. viii+312 pp., 81 figs., 63 pls., 5 appendices. $4.00.

This is the latest (and perhaps final) publication of the series describing the worthwhile archaeological endeavors of the Smithsonian Institution and National Geographic Society in southern Mexico. It is basically a report on the architecture at the famous and spectacular La Venta site in Tabasco. Work was started at this site in 1941 and terminated in 1957, but the excavations concerned with architecture were undertaken mainly in 1955. There are, however, other matters discussed and described in the monograph, which include the offerings in the site, the monuments, other nearby sites, and a summary of the culture and chronological position of La Venta.

The work on the architecture was extremely carefully planned and showed a clever manipulation of the available resources to obtain maximum information with minimum expense and effort. Furthermore, the excavation of these features is described fully and illustrated by excellent plans, drawings, and photographs.

The construction at La Venta is divided by the authors into four phases. Phase I, which has been dated by five radiocarbon samples at about 800 B.C., was the period in which the initial planning and the surveying of the site must have been done. It also saw the construction of a clay ridge around the ceremonial court, the construction of three small platforms around it, and the start of work on a larger pyramid. Also, south of the court an additional platform was constructed and four offerings were placed in the ceremonial court. Phase II, not quite so well dated but estimated at about 600 B.C., saw the excavation of the great pits, the building of a platform of 28 layers of serpentine blocks, and the construction of the two mosaic jaguar masks. It also saw two more pyramids built, the enlargement of older pyramids, and the placing of more offerings. Phase III, with a date of 574 B.C., brought more offerings and additions to pyramids already there. Phase IV, estimated as ending at 400 B.C., was the time of the construction and completion of the huge pyramid (C–1), the addition of two battered low platforms, work on the other pyramids, the erection of a large number of heavy basalt columns transported from a distant source, and more offerings. The report includes an astute discussion of the cultural implications of the pyramids and tombs.

This architectural description is followed by a discussion of the post-Phase IV materials; an excellent section on the offerings describing the pretty loot they contained and discussing their comparative and cultural implications; a section on the monuments at La Venta; and a description of materials at nearby sites.

The final section is entitled "Results and Conclusions: Cultural and Chronological Position of La Venta." It is very important for Middle American archaeologists because the La Venta–Tres Zapotes area is a key region for correlating the lowland with the highland sequences.

First the authors discuss the history of the Olmec problem. This is a good résumé, which corrects Drucker's previous correlation of Tzakol with La Venta and puts Middle Tres Zapotes and La Venta into the Formative where they belong. Next comes a survey of the geographical distribution of Olmec culture. Of particular significance here is the authors' assertion that La Venta and Middle Tres Zapotes were coeval with Tlatilco. In this they disagree with Piña Chan's 1955 correlation sequence, which placed La Venta and Middle Tres Zapotes in the Upper Preclassic along with Upper Zacatenco, Ticomán, Cuicuilco, and Teotihuacán I.

Since this report was written (early 1957), new evidence has become available on the temporal and cultural relations of Olmec to other Mesoamerican cultures. Of particular interest is Piña Chan's additional stratigraphic testing at La Venta, which revealed new figurines and ceramics that are probably pre-Phase I. It now seems likely to me that La Venta and both Middle and Lower Tres Zapotes are roughly contemporaneous and not earlier than Middle Preclassic. They appear to be of the same period as El Arbolillo I and II, Tlatilco I and II, Early and Middle Zacatenco, Chiapa de Corzo II to IV, Conchos I and perhaps Conchos II from the Ocós site in Guatemala, late Ponce and Aguilar in the Huasteca, and Mamom. Late Middle Tres Zapotes and post-Phase IV at La Venta would be Late Preclassic or Protoclassic and contemporaneous with Cuicuilco, Late Zacatenco,

Ticomán, Chila, El Prisco, Chicanel, Monte Albán I–II, and Chiapa de Corzo V–VII. This would leave only Chiapa de Corzo I, Ocós, possibly early Ponce, Pavón, and perhaps the new pre-Phase I materials found by Piña Chan at La Venta as being Early Preclassic or Village Formative.

The final section of the conclusions discusses the sociopolitical situation at La Venta. This is an excellent ending to a good report. It is a fine example of the sort of conjunctive interpretation of archaeological material that is unfortunately lacking in so many site reports in Mesoamerica.

In conclusion, I have endeavored to indicate that this La Venta report on the architecture is noteworthy addition to the literature on prehistoric Mesoamerica. And dates from the series of nine well selected and carefully interpreted radiocarbon samples firmly establish the chronological position of La Venta. Needless to say, the Olmec problem is not solved, but Drucker, Heizer, and Squier have brought new evidence to bear on its solution.

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Excavations at Nantack Village, Point of Pines, Arizona. DAVID A. BRETERNITZ. Anthropological Papers of the University of Arizona, No. 1, Tucson, 1959. xi + 77 pp., 48 figs., 5 tables. $1.75.

This is the first monograph of the new anthropological series issued by the University of Arizona. It is a larger format than the Social Science Bulletins in which some of the earlier reports based on the work of The University of Arizona Archaeological Field School at Point of Pines have appeared. The increase in the size of the type and the less crowded spacing of the material have made this paper easier to read and to use than the smaller bulletins. This type of publication in relatively inexpensive offset printing might well serve as a model which could be followed by other departments of anthropology which are trying to disseminate the results of research in the face of rising publication costs. The type face is handsome, the maps and drawings are sharp and clear, and the material is organized so that it is easy to pick out specific details. Certain areas of the half-tone illustrations are lacking in detail. This, however, is of minor consequence; even though these particular illustrations may be of inferior quality they are a welcome supplement to corroborate and explain the text and drawings.

The excavation of ten pit houses and a Great Kiva were undertaken at Nantack Village in order to arrive at further understanding of the Nantack phase dated by pottery at A.D. 900–1000. Surface rooms belonging to two small overlying ruins of the later Reserve and Tularosa phases were also excavated to obtain stratigraphic information and to help in determining a terminal date for the Nantack phase. The materials derived from these excavations are clearly described and thoroughly analyzed. The pit houses are rectangular; in most of them six posts, recessed in the walls, serve as main supports for the roof. Several of the houses have lateral entryways of the ramp type. Four houses have hearths with a lining of rocks, while others have hearths with a lining of clay. Breternitz conjectures that the large rocks placed around the edge of the house-pit at some of the houses were basal supports for walls, possibly of jacal construction. In general ground plan and pattern of posts for the roof these houses are much like those assigned to roughly contemporary phases of the neighboring Mogollon Branches. However, the hearths lined with rocks and the large rocks used for basal supports for upper walls above the pit suggest a departure from the normal Mogollon pattern and are probably a later development.

The Great Kiva is also not closely comparable to most of the Mogollon ceremonial structures of this general period. It is rectangular, has a broad lateral entryway and ten quite large roof-posts placed asymmetrically. The surface rooms are rectangular contiguous structures built of core and rubble masonry. They appear to be generally similar to those of the Reserve and early Tularosa phases in other areas to the east. Ruin B is assigned to the Tularosa phase and has certain architectural features (such as a masonry partition wall within one room) which are typical of this phase.

The ceramics from the pit houses are generally comparable to those of other Mogollon sites of this era, particularly those of the Three Circle phase. The principal differences are: (1) the presence of two new types, one neck corrugated and the other red-on-brown; (2) an unusual amount of textured pottery with elaborate surface treatment; and (3) the large number of sherds recovered. Although the pottery from the surface rooms corresponds generally to that from the ruins of the Reserve and Tularosa phases in areas to the east, there is a surprising paucity of Reserve Black-on-White and Tularosa Black-on-White as compared to Encinas Red-on-Brown. The textured types are more nearly the same.

With the exception of a painted stone bowl and a quadruped effigy resembling a bear — traits which Breternitz has compared with objects found in later phases — most of the stone and bone artifacts fall quite easily into the pattern of types and frequencies found normally in villages of the Three Circle or coeval phases.

The author places the terminal date for the Nantack phase at A.D. 1000. One might regret that use was not made of additional comparative data, hints of which appear in the ceramic frequencies and in some of the architectural traits mentioned above. However, the absence of more precise dating techniques other than cross-dating by pottery renders any more definite resolution of the problem impossible. A slanting horizon in the direction of 1050 or a delicate shading off in the manner of a spectrum might have been preferable. Perhaps the Reserve phase began at 950, as some archaeologists have suggested, and there is a blending or overlapping between it and the earlier phases. These are merely possibilities and reflect the current lack of precise dating in the Mogollon area for the period between 900 and 1280 rather than any

basic defect in the report. The publication manifests careful, competent field techniques, adequate, thoughtful research, and perceptive insights into the possibilities of the material.

John B. Rinaldo
Chicago Natural History Museum
Chicago, Ill.

The Harroun Site: A Fulton Aspect Component of the Caddoan Area, Upshur County, Texas. Edward B. Jelks and Curtis D. Tunnell. Archaeology Series, No. 2, University of Texas, Austin, 1959. 63 pp., 16 figs., 1 table. $1.00.

This report describes the excavations and findings made over a period of three years (1957–59) at a small site, apparently of the Titus focus, located in the extreme northeastern corner of Upshur County, Texas. The Harroun site is one of several investigated in the Ferrell's Bridge Reservoir area as a part of the Inter-Agency Archeological Salvage Project. It is the first fully reported Caddoan site excavated by a recent salvage project in Texas.

Most prominent features at the Harroun site were four small, oval mounds and a probable borrow pit. Excavation of the mounds revealed that one, Mound A, had been erected to cover a burial. The remaining three mounds each contained the charred remains of at least one circular structure. The absence of domestic refuse, coupled with the intentional burning and burial of the structures, seem to suggest that they were ceremonial in function. Trenching between and around the mounds failed to unearth other Titus focus occupational features, although a few artifacts from a brief pre-mound occupation probably affiliated with the Archaic, were found.

Because of time limitations, all four mounds were not completely excavated. However, the technique of excavation employed, described in considerable detail in the report, was such that it yielded surprisingly complete data on mound construction. In brief, each mound was divided into, and excavated by, quadrants. Vertical profiles as well as frequent floor sketches were made of each quadrant dug. The advantage of this system is that the excavation of two opposing quadrants will yield two complete cross-section profiles of the mound and a good floor plan of major structural features.

In spite of a low artifact yield, the Harroun site contributes to Caddoan archaeology. Evidence from this and several other Fulton aspect sites clearly indicates that mounds were constructed in the Caddo area much later than previously believed, and that they are not restricted to the earlier Gibson aspect. Perhaps, however, it is more important that the findings at the Harroun site call attention to the overly rigid definition of Caddoan foci. Foci of both the Gibson and Fulton aspects have been defined, because of the limited number of excavations in the Caddoan region, by collections from a few or, in some cases, a single site. As a result, sites such as Harroun appear typical in some respects, but atypical in others. Perhaps, as the authors suggest, the concept of the Titus focus rather than the Harroun site needs to be questioned.

The authors' conclusion that Harroun is largely a ceremonial Titus focus site of fairly short duration seems well substantiated by the data presented. However, the interpretative section of the report is brief and there is little attempt to cope with some of the broader problems in Caddoan archaeology. Possibly the few artifacts recovered and small size of the site do not provide a sufficient basis for such a discussion. Nonetheless, the care with which the site has been described makes the Harroun report a valuable and welcome addition to the literature of Caddoan archaeology.

Dee Ann Suhm
Texas Memorial Museum
Austin, Tex.

Report of the Investigations of the Payne Site 39WW302, Walworth County, South Dakota. Roscoe Wilmeth. South Dakota Archeological Commission, Archaeological Studies, Circular No. 8, Pierre, 1958. vii+42 pp., 24 figs., 2 charts.

This is the latest in a series of reports, which have been appearing with admirable regularity, on salvage work in the Missouri Valley done jointly by the South Dakota Archaeological Commission, the W. H. Over Museum of the State University of South Dakota, and the National Park Service. The Payne site is a small village site in the Oahe Reservoir area, northern South Dakota. The site, surrounded by a double palisade, was large enough to have accommodated perhaps eight earth lodges, but only two house rings were visible. Both were investigated. The houses were circular with four large center posts, a double ring of peripheral posts, and entrance passage to the southwest. One house had central and auxiliary fireplaces and shallow interior pits. In the other, no floor features were found. Horticultural activities are signified by scapula hoes, with heads unmodified and with spinal and post-scapular processes removed. Abundant animal bones, predominantly of bison, point to the importance of hunting, although only three arrowpoints and 13 scrapers were found out of more than 200 non-ceramic artifacts. The pottery was primarily simple stamped. Decoration was mostly by incision (mainly Nordvold Horizontal Incised and Le Beau S-Rim Incised) and tool impression (Akaska Tool Impressed), with minor occurrences of cord impression. Rims were S-shaped or straight to flaring, on globular bodies.

The materials are closely related to those from Swan Creek A, Blacktail, and 39WW300, and the four components are grouped by Wilmeth into the Akaska focus, within the already established Chouteau aspect. The dominance of S-rims is the chief distinction between the Akaska focus and the other three Chouteau foci — La Roche, Shannon, and Bennett — although other ceramic distinctions are also present. The Akaska focus is thought to fall late in the time of the Chouteau aspect, about A.D. 1650–1700. Wilmeth traces the major Akaska focus traits

from a number of sources. For instance, the circular earth lodge is derived from Arzberger and is diffusing northward; horizontally incised pottery is also from Arzberger; S-rims are from the Huff focus; cord-impressed decoration is apparently diffusing southward and at the time of the Akaska focus was just beginning an increase in popularity, which eventually resulted in its replacing incised decoration.

This is a concise, readable report, a workmanlike addition to a workmanlike series. Descriptions are brief but adequate, and the data are amply supplemented by plans, profiles, and artifact illustrations. The report is, unfortunately, marred by typographical errors, references to nonexistent pages (doubtless manuscript page numbers), and poor reproduction of photographs; these difficulties, we understand, were beyond the control of the author. The series as a whole has suffered from highly variable quality of printing, resulting from the system of farming out printing for the state of South Dakota. Otherwise it is one of the best state-sponsored archaeological publication series.

E. Mott Davis
University of Texas
Austin, Tex.

Modoc Rock Shelter: A Summary and Analysis of Four Seasons of Excavations (1952, 1953, 1955, 1956). Melvin L. Fowler. Illinois State Museum, Report of Investigations, No. 8, Springfield, 1959. 72 pp., 19 figs.

In this tightly written monograph Fowler has presented the distilled essence of four seasons of intensive field work and many hours of laboratory study of a site that is unique in the eastern United States. In eight succinct chapters the Modoc Rock Shelter is described physically and geologically; dated by an array of radiocarbon determinations; analyzed in terms of artifacts, habitations, burials, and faunal remains; and related to a proposed interpretation of ecological process in the central Mississippi Valley from 8000 to 2000 B.C. The Modoc site itself is unique in several ways. It is a deep stratified site of the Archaic period — the only such known at the time of initial discovery. It has produced radiocarbon dates of human occupation ranging back to almost 8000 B.C. Fowler's analysis has clearly demonstrated the variety of artifactual remains which help to extend the concept of "Archaic" back to a time period which was considerd "Paleo-Indian" in 1956.

In his introductory chapter Fowler proposes to carry out his study using the conjunctive method outlined by Taylor in "A Study of Archeology." Whether he uses the specific methodology suggested by Taylor or not is irrelevant to me. What he does accomplish is in line with the spirit of the conjunctive method. The site is his prime focus of interest, and although it was not exhaustively excavated (as Taylor would probably prefer), the sampling was wide and deep. Most important, all the evidences relating to man's use of the site are exhaustively analyzed and related to each other in terms of a dynamic interest in the site. This dynamic concern is expressed primarily in artifact analysis and interpretation aimed at deriving functional relationships within a context of time change. To this focus on the site itself is added a realistic emphasis on related materials from surrounding areas. Fowler makes use of comparative archaeological, as well as ecological, data in order to present a study of one site that is both functional (in terms of reconstructing living communities), historical (in his emphasis on the continuity and change demonstrated by time depth), and comparative (as it suggests chronological and ecological factors of more than local significance).

An interesting facet of the study is the application of the "type-cluster" classification concept to projectile point styles. This procedure has not been developed far by Fowler, but offers interesting possibilities for interpretation of preceramic units. Another unusual aspect of the study is included in the chapter called "Ecological Adaptation in the Central Mississippi River Valley, 8000 to 2000 B.C." Tying together the regional cultural varieties with the chronology and cultural variety demonstrated at Modoc, Fowler posits three broad Archaic periods, largely on ecological grounds: *Initial Archaic* (8000–6000 B.C.); *Local Adaptation* (6000–4000 B.C.); and *Specialized Adaptation* (4000–2000 B.C.). His unique contribution here lies in the extent to which he has documented and supported his interpretations, especially in the period of Specialized Adaptation. Here he convincingly argues for the interpretation of several late Archaic sites as seasonal habitations of one cultural group.

The presentation of the report is uniformly excellent, well organized, well illustrated, and well laid out. This book is a model that follows the high standards set by the author and the Illinois State Museum in previous publications. Basic data are efficiently presented in tables and illustrations. Table 13, "Depth Distribution of Artifacts at the Modoc Rock Shelter. . . ." is a complete trait list for the site, which apparently was added to the report late in the process of editing. It lacks numerical totals, and subsequent tables are misnumbered in the text. However, these two editorial faults detract only minutely from a significant and well done report.

William J. Mayer-Oakes
University of Oklahoma
Norman, Okla.

An Archaeological Study from Martha's Vineyard. E. Gale Huntington. The Dukes County Intelligencer, Vol. 1, No. 2, Dukes County Historical Society, Edgartown (Massachusetts), 1959. 10 pp., 9 plates. $0.50.

This paper is an account mainly of the excavation of a shellheap on Lagoon Pond, Martha's Vineyard. The site has been known for many years and has been severely disturbed by many non-professional excavators. This report is a non-professional attempt to make some record of the excavation of approximately 800 square feet of the site. The account is confusing and incomplete and the

comments concerning the artifacts are naive in the extreme. Nevertheless, it is possible to glean a small amount of information concerning a sequence of artifact types, for the site was almost certainly stratified. The lower material is of shale and was found in the underlying yellow soil; the stemmed arrowpoints and other tools are commonly found in some phases of the Archaic in southeastern New England. Above these lie later Archaic tools in a brown soil, and finally, near the top, steatite vessels and grit-tempered pottery appears. In the overlying shell-heap grit-tempered pottery and shell-tempered pottery are found. There is apparently a change in artifact types from bottom to top but the record given is more frustrating than informative.

Frederick Johnson
R. S. Peabody Foundation
Andover, Mass.

The Prehistoric People of Accokeek Creek. Robert L. Stephenson. Alice Ferguson Foundation, Accokeek (Maryland), 1959. 35 pp., 13 figs., 1 table. $1.00 ($0.60 to scientific institutions and libraries).

This brief paper, designed for popular consumption and preliminary to a longer, technical report to follow soon, admirably presents the story of the successive occupations of the Accokeek Creek site, Prince George's County, Maryland, "as simply and understandably as possible." It more than fulfills the relatively limited aim of the Foundation "to contribute a publication of educational value in summarizing the long pre-history of this area and of general interest to its present inhabitants." Stephenson's non-technical treatment of the data is derived from a complicated and difficult analysis of archaeological materials he did not excavate and from field notes, sketches and maps he did not make. It has appeal for all students of the archaeology of the middle Atlantic region. While the paper speaks the language of the amateur, it carries the authority of the competent professional.

Having been denied both a stratigraphic foundation and the benefits of radiocarbon dating, Stephenson bases his cultural reconstruction of the site on typological analyses of excavated materials and features. Beyond a short explanation of the principles involved, he defers to the "popular" slant of this paper and avoids detailed scientific discussions. From his diagnoses he derives seven occupations of the site, in relative, not absolute, time, beginning with a group of Archaic people about 3000 B.C., followed by the Marcey Creek and the Pope's Creek peoples in Early Woodland times, about 500 B.C. to about A.D. 300. These were succeeded by the Accokeek People and the Mockley people during the Middle Woodland period up to about A.D. 1200, the Potomac Creek people in the Late Woodland period and, finally, by a group of Susquehannocks for a brief historical moment in the late 17th century.

Using pottery as his chief index, Stephenson suggests that the Marcey Creek people evolved from the Archaic occupants and that the Pope's Creek people were immigrants from the north who supplanted them. The Accokeek people, descendants of these migrants, in turn appear to have been ancestral to the Mockley people. Evidence seems to indicate that sometime after its abandonment seven or eight hundred years ago, a second group of northerners, the Piscataway tribe of the Potomac Creek Indians, of Algonkian stock, reoccupied the site and remained there to witness the advent of the colonial period. Difficulties which developed between them and the encroaching white settlers and a foray by raiding Seneca Indians forced the Potomac Creek people to abandon the site in favor of another location nearby. In 1674 a band of Susquehannocks from southeastern Pennsylvania built a fort on a portion of the Accokeek Creek site but after a siege by forces from Virginia and Maryland in September 1675 made good their escape. Thereafter, the site, which had fostered aboriginal settlement for upwards of 5000 years, passed into the hands of the white man.

Stephenson skillfully draws upon the more than 200,000 potsherds, 9000 projectile points, chipped and ground stone tools, bone implements, ornaments, smoking pipes, 17,000 postmolds and 1000 burials excavated from three distinct areas of the site by Mrs. Alice L. L. Ferguson, whose untimely death in 1951 cut short her enthusiastic investigations. He briefly summarizes her field notes, carefully utilizes a topographical interpretation prepared by Henry C. Ferguson, and blends historical fact into the archaeological perspective. Illustrations of pottery types, smoking pipes, bone tools and projectile points whet the appetite for more, and one anticipates, with relish, the publication of the full-scale report.

H. G. Omwake
Governor Bacon Health Center
Delaware City, Del.

Archaeological Investigations of the Castle Windy Midden, Florida. Ripley P. Bullen and Frederick W. Sleight. William L. Bryant Foundation, American Studies, Report No. 1, 1959. vi+32 pp., 3 figs., 9 pls., 2 tables. $0.75.

This first report of a new publication series deals with work at the Windy Castle site, a shell midden near New Smyrna Beach, Florida. The results of this work have important ramifications in the prehistoric cultural development of northeastern Florida. The major contributions of the excavations and the site report were the establishing of a series of radiocarbon dates for a Florida coastal midden and a clearer understanding of the chronological position of the Halifax series pottery. Bullen and Sleight conclude from radiocarbon dates and other data that the site was first occupied about A.D. 1000 and abandoned about 1350. However, in the chronological discussion there is some shadow on the interpretation of the radiocarbon dates. The dates involved include A.D. 1307 from a charcoal deposit 1.5 feet below the top of the midden,

1027 for charcoal from the base of the middle zone, and 1047 for charcoal from the lower zones. All of the dates have a plus or minus figure of 100 years. The authors offer the following interpretation.

> These dates indicate that the loose oyster shells of the lowest zone accumulated very rapidly (there being no essential difference between the dates for depths of 10–10.5 and 14–17 feet), that the site was first occupied somewhat earlier than A.D. 1027 — probably about A.D. 1000, and that the site was abandoned after A.D. 1300 — probably about 1350. The Castle Windy site was occupied, therefore, over a period of about 350 years.
>
> Obviously, there are in general, two ways to handle the Castle Windy radiocarbon dates. If one subtracts the allowance in years from the latest date and adds the allowance to the earlier (averaged) date, the result would be A.D. 1207 and A.D. 1137. This would "compress" the history of the site into 70 years. Reversing the process would expand the life of the site to about 450 years. We prefer the interpretation given in the previous paragraphs.

This whole interpretation ignores the statistical use of standard deviation whereby there is a 65% probability that the true date falls within one standard deviation on either side of the mean.

The radiocarbon dates show that the Halifax pottery series started earlier than was formerly thought. The Halifax series was initially described by Griffin and Smith (1949) after an excavation of the Nocoroco site about 40 miles northwest of Castle Windy. The appearance of this pottery in this particular area suggests interesting speculation as to the ethnic origin of these peoples who carried a pottery tradition unlike the indigenous St. Johns peoples. Since the Halifax series is unique for Florida in the period bracketed by the above radiocarbon dates and obviously is related to the later San Marcos Ware, we are confronted with an interpretation that has yet to be resolved. The report includes an unusually good discussion and interpretation of the food remains found.

HALE G. SMITH
Florida State University
Tallahassee, Fla.

NOMINATING COMMITTEE FOR 1960–61

Article II, Section 2 of the By-Laws requires the publication of the following information:

1. Names and addresses of the members of the 1960–61 Nominating Committee: Richard B. Woodbury (Chairman), Department of Anthropology, University of Arizona, Tucson, Arizona; Jesse D. Jennings, Department of Anthropology, University of Utah, Salt Lake City, Utah; George Quimby, Chicago Natural History Museum, Chicago 5, Illinois.

2. List of offices for which nominations will be made: President-Elect (one-year term, will serve as President in 1962–63); Treasurer (four-year term); two members of the Executive Committee (two-year terms).

3. Reminder that members may suggest the names of candidates for these offices to the Nominating Committee before December 1, 1960.

ANNUAL MEETING OF THE SOCIETY FOR AMERICAN ARCHAEOLOGY, 1960

The 25th Annual Meeting of the Society for American Archaeology was held on Thursday, Friday, and Saturday, May 5–7 on the campus of Yale University, New Haven, Connecticut.

Meeting of the Executive Committee

As required by Article VI, Section 3, of the Society's Constitution, the annual meeting of the Executive Committee was held prior to the annual business meeting of the Society. An account of this meeting is included in the report of the Secretary.

Annual Business Meeting

The annual business meeting was called to order by President Jesse D. Jennings at 2:30 P.M. on Friday, May 6, 1960, with 67 members present during the business session.

The minutes of the 24th Annual Meeting were approved as published in American Antiquity, Vol. 25, No. 2, pp. 291–7 (October, 1959).

The reports of the Secretary, Treasurer, and Editor (all printed below) were read and accepted by the membership.

The Elections Committee (David A. Baerreis, Chester S. Chard, William S. Laughlin) reported the results of the mail ballot (398 ballots received) as:

President-Elect: Junius B. Bird

Secretary: Joe Ben Wheat

Members of the Executive Committee (to 1962): Ignacio Bernal, Charles E. Borden

New Business

Clifford Evans reported that research on obsidian dating would be continued at the Smithsonian Institution for a three year period. Help of the membership is needed to collect obsidian specimens while in the field. Particularly desired are specimens collected by stratigraphic level.

President Jennings presented the background of a suggestion directed to the Executive Committee concerning the need for the establishment of professional standards and a code of ethics. He indicated that the Executive Committee did not want to act on this problem without having the advice and opinions of the members. Following extensive discussion from the floor touching upon these two problems and raising, in addition, the question of the desirability of a reorientation of the membership of the Society so as to differentiate a professional group, a motion was passed instructing the Executive Committee to appoint a broad committee to explore these questions. It was suggested that the recommendations be distributed to the members before the next business meeting so that they might be adequately considered before acting upon them.

The question of modification in election procedure was raised but resulted in no recommendations for a change in procedure.

The following resolutions were presented by the Committee on Resolutions (Donald Collier, Douglas S. Byers) and accepted by the membership:

Be it resolved: The Society for American Archaeology is grateful to Yale University, the Department of Anthropology of Yale, the Division of Anthropology in Yale Peabody Museum, and the Human Relations Area Files for their hospitality to the 25th Annual Meeting; to the Program Committee (J. L. Giddings, Frederick Johnson, Cornelius Osgood, Gordon R. Willey) and its Chairman, Irving Rouse, for a stimulating and well arranged program; and to the Local Arrangements Committee (Patrick Gallagher, Frank W. Moore, Gustavus D. Pope) and its Chairman, James A. Bennyhoff, for a smoothly run meeting and delightful weather.

The Society for American Archaeology expresses its warm thanks to David A. Baerreis for his services to the Society as Secretary during the past four years.

The Society for American Archaeology notes with deep regret the loss by death during the year of three members, Will L. Hall, Paul Kosok, and Stanley A. Stubbs, and extends to their families its sympathy.

The annual business meeting adjourned at 4:17 P.M.

Annual Dinner

The annual dinner was held at 7:00 P.M. May 6 at the Hotel Taft. Douglas S. Byers served as Toastmaster and presented to Carl E. Guthe a citation, accepted on his behalf by Alfred K. Guthe, which read:

> To Carl E. Guthe, devoted scholar, eminent archaeologist, successful museum administrator, authoritative museologist. He served the National Research Council with skill as Chairman of the Committee on State Archaeological Surveys, making an outstanding contribution to interregional understanding and cooperation among American archaeologists. He assumed a leading role in organizing the Society for American Archaeology; as Secretary-Treasurer during its formative years, and later, as President, he gave unsparingly of his time and energy to advance the welfare of the Society. For his notable work in advancing rigorous archaeological techniques, encouraging cooperation among students of archaeology, and thus expanding knowledge of earlier civilizations and their impact on current society, we inscribe this testimonial of esteem and appreciation.

The citation was prepared by a committee consisting of Will C. McKern, Fay-Cooper Cole, and Douglas S. Byers.

Following the dinner an address was given by Geoffrey Bushnell, Museum of Archaeology and Ethnology, Cambridge University, titled, "An Old World View of New World Prehistory." Thanks to the generosity of the Wenner-Gren Foundation it was possible to bring to the meeting both Bushnell and Helge Larsen of the Nationalmuseet, Copenhagen, Denmark, the latter to participate in the symposium, "Twenty-five Years of American Archaeology."

Other Sessions

Thursday Morning, May 5:

Opening remarks by Jesse D. Jennings and Greetings by S. Dillon Ripley, Director, Yale Peabody Museum.

Symposium: Cultural Relations Between the Arctic and Temperate Zones of North America. Diamond Jenness, Chairman.

Part 1. New-found Evidence Bearing upon Far-northern Ties to Temperate Zone Archaeology.

John M. Campbell: Cultural Succession at Anaktuvuk Pass.

J. L. Giddings: Notched-point Horizons near Bering Strait.

Charles E. Borden: West-Coast Crossties with Alaska.

R. S. MacNeish: Sites of the Yukon Territory.

Elmer Harp, Jr.: Sites in Keewatin.

George Quimby: The Old Copper Culture and the Copper Eskimos — an Hypothesis.

Jørgen Meldgaard: Sites of the Eastern Arctic.

William E. Taylor: Three Seasons in Ungava.

William A. Ritchie: Northeastern Crossties with the Arctic.

Part 2. Round-table Discussion of Relationships Between the Arctic and the Temperate Zone.

Henry B. Collins: Greenland to Bering Strait.

Froelich Rainey: Northeast Asia to Alaska.

William Laughlin: Bering Strait to Puget Sound.

R. S. MacNeish: The Barren Lands to the Great Lakes.

James B. Griffin: Washington to Maine.

Douglas Byers: Greenland to New England.

Thursday Afternoon, May 5:

Contributed Papers: Arctic and Northwestern Archaeology. Chester S. Chard, Chairman.

William N. Irving: A Provisional Comparison of Some Stone Industries in Alaska and East Asia.

Robert E. Ackerman: Culture Contact in the Bering Sea — Birnirk-Punuk Period.

William S. Simmons: Faunal Remains from the Newly Discovered Choris Site, Alaska.

Moreau S. Maxwell: The Movement of Cultures in the Canadian High Arctic.

Robert E. Greengo: A Recently Discovered Artifact Complex in Western Washington.

Contributed Papers: Archaeological Method and Theory. Albert C. Spaulding, Chairman.

John M. Corbett: Necessity for a Broader Coordinated Approach to Salvage Archaeology.

Wilfrid D. Logan: National Survey of Historic Sites and Buildings.

Ralph S. Solecki: Aerial Photography and American Archaeology — the Present Status and the Future.

G. R. Lowther: Epistemology and Archaeological Theory.

Raymond H. Thompson: Cultural Decline — a Problem in Archaeological Interpretation.

Jerome A. Donson: The Gathering, Exhibiting and Circulating of the Exhibition "Prehistoric and Indigenous Indian Art."

Contributed Papers: Central and South American Archaeology. Clifford Evans, Chairman.

Arden R. King: Ring and Pedestal Based Pottery Forms in Nuclear America.

Michael D. Coe: Chahuite Escondido, a Stratified Site in Northwestern Costa Rica.

S. K. Lothrop: Archaeological Sequence in Southwestern Costa Rica.

Robert E. Bell and W. J. Mayer-Oakes: An Early Lithic Site near Quito, Ecuador.

Dwight T. Wallace: Settlement Patterns on the South-Central Coast of Peru.

Donald W. Lathrap: Archaeology of the Cave of the Owls.

Thursday Evening, May 5:

Symposium: Teaching of Archaeology. Jesse D. Jennings, Chairman.

Richard B. Woodbury: Objectives and Concepts in the Teaching of Archaeology in Undergraduate Courses.

Alfred Kidder, II: Course Design.

David A. Baerreis: Techniques of Teaching Archaeology.

Friday, May 6:

Symposium: Twenty-five Years of American Archaeology. Frederick Johnson, Chairman.

Helge Larsen: Arctic Area.

William G. Haag: Eastern United States.

Waldo R. Wedel: Plains Area.

Clement Meighan: Western United States.

Robert H. Lister: Greater Southwest.

Gordon R. Willey: Nuclear America.

Irving Rouse: Lowland South America and the Caribbean.

Saturday Morning, May 7:

Contributed Papers: Northeastern Archaeology. Alfred K. Guthe, Chairman.

Douglas F. Jordan: Recent Data from the Bullbrook Site, Ipswich, Massachusetts.

Maurice Robbins: An Archaic Village in Middleboro, Massachusetts.

W. Fred Kinsey and John Witthoft: The Sheep Rock Shelter — a Dry Site in Central Pennsylvania.

Don W. Dragoo: Adena Chronology in the Ohio Valley.

Elden Johnson: Three Early Woodland Sites in Minnesota.

Contributed Papers: Southwestern and Iowan Archaeology. Paul S. Martin, Chairman.

Joe Ben Wheat: Porter Pueblo and Its Ceramic Complex.

Richard B. Woodbury: A Re-appraisal of Hohokam Irrigation.

J. Charles Kelley: Archaeological Evidence for the Mesoamerican Origins of Pueblоan Religion.

Jeremiah F. Epstein: Culture Sequences in the Lower Pecos River Area, Texas.

George A. Agogino and W. D. Frankforter: The Brewster Site and Other Agate Basin Sites in Eastern Wyoming.

W. D. Frankforter and George Agogino: The Simonson Site, Iowa's First Paleo-Indian Site (Second Year Report).

Contributed Papers: Mayan and Bahaman Archaeology. Robert Wauchope, Chairman.

Barbara C. Rands: Excavations in a Maya Cemetery at Palenque.

William C. Root: The Gold Bell from Palenque.

Robert L. Rands: Elaboration and Invention in Ceramic Traditions.

Linton Satterthwaite: New Radiocarbon Dates at Tikal and the Maya Correlation Problem.

Robert M. Adams, Jr.: Archaeological Reconnaissance in Highland Chiapas, Mexico.

John M. Goggin: The Archaeology of San Salvador Island.

Saturday Afternoon, May 7:

Contributed Papers: Southeastern Archaeology. James A. Ford, Chairman.

Douglas W. Schwartz: The Stone Grave Problem in Kentucky.

James B. Shaeffer: A Survey of the Kermac Ranch, Poteau, Oklahoma.

Stephen Williams: Excavations at the Lake George Site, Yazoo County, Mississippi, 1958–59.

William H. Sears: Weeden Island — a Review.

Ripley P. Bullen: The Palmer Site, Osprey, Florida.

Contributed Papers: Archaeology and Environment. Edward S. Deevey, Chairman.

Jacob W. Gruber: Brixham Cave and the Origins of Prehistory.

Rhodes W. Fairbridge: Quaternary Climatic Change and Sea Level Oscillation.

William E. Edwards: The Late Pleistocene Extinction of Many Mammalian Species.

Paul S. Martin: Early Man and Extinction; Is Circumstantial Evidence Enough?

Paul B. Sears and Monica Bopp: Pollen Studies of Cave Sediments.

James Schoenwetter: A Progress Report on Pollen Analysis in the Mesa Verde Area.

Contributed Papers: Mesoamerican and Marquesan Archaeology. Ignacio Bernal, Chairman.

Pedro Armillas: Mesoamerican Chronology, an Early 1960 Look.

William J. Mayer-Oakes: Ceramic Typologies in the Valley of Mexico.

Harriette H. Thomsen: Pre-Conquest Fired Brick — Identification and Verification.

Carl B. Compton: Observations on the Petroglyphs of Coahuila, Mexico.

Robert C. Suggs: The Derivation of Marquesan Culture.

Report of the Secretary

Committees. The following regular committees were appointed by President Jesse D. Jennings and approved or elected by the Executive Committee as required by the Constitution and By-Laws of the Society.

Nominating Committee: Watson Smith (Chairman), J. L. Giddings, Jr., Charles R. McGimsey.

Viking Fund Award Committee: J. D. Jennings (Chairman), Charles E. Borden, J. O. Brew, Carl H. Chapman, Chester S. Chard, Donald Collier, J. L. Giddings, Marvin F. Kivett, Clement Meighan, Frank H. H. Roberts, Joe Ben Wheat.

Program Committee: Irving Rouse (Chairman), J. L. Giddings, Frederick Johnson, Cornelius Osgood, Gordon R. Willey.

Local Arrangements Committee: James A. Bennyhoff (Chairman), Patrick Gallagher, Frank W. Moore, Gustavus D. Pope.

Resolutions Committee: Donald Collier, Douglas S. Byers.

Elections Committee: David A. Baerreis (Chairman), Chester S. Chard, William S. Laughlin.

Donald Collier and Erik K. Reed were appointed delegates to the Chicago Darwinian Centennial. Elmer Harp, Jr., and Chester S. Chard were appointed delegates to the Sixth International Congress of Anthropological and Ethnological Sciences in Paris to be held in August, 1960. The latter was also appointed a delegate to the forthcoming International Congress of Americanists. Terah L. Smiley was appointed official delegate to the Organizational Committee of the International Association on Quaternary Research.

Irving Rouse was chosen by the Viking Fund Award Committee as the 1959 medalist.

The Nominating Committee presented the following names for the 1960 election of officers: for President-Elect, Junius B. Bird and J. Charles Kelley; for Secretary, Joe Ben Wheat; for first Executive Committee member (to 1962) Ignacio Bernal, Henry B. Collins, Elmer Harp, Jr.; and, for Second Executive Committee member (to 1962), Charles E. Borden, Gordon Vivian, and Stephen Williams.

The Executive Committee held a special meeting at Salt Lake City, Utah, May 2, 1960, and its regular meeting at New Haven, Connecticut, May 4, 1960. Its actions during the fiscal year (other than approval of the appointments and committee actions noted above) included the acceptance of the invitation of the University of Arizona to hold the 1962 annual meeting at Tucson and the invitation of the University of Colorado to hold the 1963 annual meeting at Boulder. The Executive Committee approved the Editor's, Treasurer's and Secretary's reports for 1959–60 and the proposed budget (as modified by committee action) for 1961–62 as prepared by the Treasurer. The special actions listed below were also authorized by the Executive Committee.

The Treasurer was authorized to make greater use of the office of the Executive Secretary of the American Anthropological Society in the payment of bills, preparation of a financial report, development of an integrated mailing list, and other activities of a routine character connected with his office. Such action in no manner affects his responsibility for the general supervision of the financial affairs of the Society nor in any manner affects his responsibility in the preparation of an annual budget.

During the course of the year, the Executive Committee prepared and adopted "A Resolution Condemning Acts of Vandalism at Archaeological Sites in, and Illicit Export of Prehistoric Treasures from, the Republic of Mexico" the text of which is hereby given for insertion in the published records of the Society:

Whereas: Unauthorized and unscientific digging in prehistoric sites in the Republic of Mexico is extensively carried on in order to recover prehistoric objects and art treasures for ultimate export to foreign collectors in defiance of the laws of the Republic of Mexico, and

Whereas: Each instance of such illegal export of prehistoric objects from the Republic of Mexico which comes to the attention of the public press of Mexico is widely advertised in feature articles and editorials, thereby increasing the difficulties of Mexican archaeologists and impairing public relations of non-Mexican archaeologists engaged in research projects, and

Whereas: Difficulties faced by the Instituto Nacional de Antropología e Historia of the Republic of Mexico, charged with the duty of overseeing Mexican anthropology, have recently been set forth by Dr. E. Dávalos Hurtado ("La Defensa del Tesoro Cultural de Mexico," *Miscellanea Paul Rivet, Octogenario Dicata*, XXXI Congreso Internacional de Americanistas, Vol. I, pp. 439–42, Universidad Nacional Autónoma de México, 1958), and

Whereas: The curbing of commercialism and illegal export of Mexican antiquities is most desirable in order to preserve the patrimony of the Mexican people and to permit continued scientific investigation of the prehistory of Mexico by qualified foreign workers, and

Whereas: The objectives of the Society for American Archaeology, as stated in its constitution, Article II, are (Section 1) "The objects of the Society shall be to promote and to stimulate interest and research in the archaeology of the American continents; to encourage a more rational public appreciation of the aims and limitations of archaeological research; to serve as a bond among those interested in American Archaeology, both professionals and non-professionals, and to aid in directing their efforts into more scientific channels; to publish and to encourage the publication of their results; to foster the formation and welfare of local archaeological societies; to advocate and to aid in the conservation of archaeological data; and to discourage commercialism in the archaeological field and to work for its elimination." (Section 2) "The practice of collecting, hoarding, exchanging, buying, or sell-

ing archaeological materials for the sole purpose of personal satisfaction or financial gain, and the indiscriminate excavation of archaeological sites are declared contrary to the ideals and objects of the Society."

THEREFORE, BE IT RESOLVED: That the Society for American Archaeology condemns all vandalism of archaeological sites and the contraband trade in Mexican antiquities as destructive of the priceless cultural heritage of prehistoric art and archaeology of the people of the Republic of Mexico, as ruinous of proper and desirable relations between the people of the United States and the people and government of the Republic of Mexico and as inimical to continuance of scientific archaeological studies by foreign scholars.

And further,

BE IT RESOLVED: That the Executive Committee of the Society for American Archaeology pledges itself to use every means to uphold the National Antiquities Act of the Republic of Mexico by cooperating with the Republic of Mexico in efforts to curb illicit traffic in antiquities.

By this action the Society for American Archaeology, through its Executive Committee, pledges its support to the Republic of Mexico in its attempts to preserve archaeological sites in Mexico and prevent the contraband trade in Mexican antiquities.

The secretary of the Society for American Archaeology is instructed to forward copies of this resolution to the American Association of Museums, the U.S. Customs Service, the Customs service of the Republic of Mexico, the Instituto Nacional de Antropología e Historia of the Republic of Mexico, the American Anthropological Association, the Secretary of Public Education of the Republic of Mexico, the museums and monuments division of UNESCO.

The resolution was presented by President Jennings to Ignacio Bernal at the annual meeting of the American Anthropological Association at Mexico City, December 30, 1959, and mailed to the other officials designated in the resolution. In addition to responses which indicated the gratification of the officials of the Republic of Mexico for the concern expressed by our Society, a letter was also received from D. D. Strubinger, Acting Commissioner of Customs of the U.S. Treasury Department. Mr. Strubinger expressed appreciation of our interest in the prevention of smuggling from Mexico and their willingness to take action when such acts could be apprehended. In presenting this action of the Executive Committee to the Society for approval, it was indicated that our concern with proper ethical and moral behavior regarding the importation of antiquities was one which extended to all regions, not just the Republic of Mexico.

Henry Hutchinson, President of the Sussex Society of Archeology and History, acting on behalf of his Society, presented a petition requesting the acceptance of the Sussex Society of Archeology and History as an affiliate of the Society for American Archaeology as provided in Article VI of the By-Laws of our Constitution. In view of the lack of precedent for such an action, for no other organization has as yet become an affiliate, as well as its serious nature and possible consequences, it was moved and passed that the petition be tabled until the President has an opportunity to appoint a committee to establish criteria and policy for the acceptance of affiliates.

An attempt was made to bring two Russian anthropologists, M. J. Levin and A. P. Okladnikov, to the annual meeting, the invitation being extended under Articles 6 and 13 of the "Agreement on Exchange of Scientists" negotiated by the National Academies of Sciences of the U.S.A. and the U.S.S.R. Although, perhaps due to brevity of time limitations, it was not possible to complete the arrangements, the idea of such an exchange of archaeologists met a very sympathetic and appreciative reception in the U.S.S.R.

Discussion on the Nominating Committee procedure and the need for a statement on a code of ethics and suitable professional standards for archaeological work was held, but action was deferred pending further discussion of matters at the annual business meeting of the Society.

Respectfully submitted,

DAVID A. BAERREIS, *Secretary*

REPORT OF THE TREASURER

The increase in cost of the new format of AMERICAN ANTIQUITY has not yet been balanced by increased revenue anticipated chiefly from new members. The Working Fund budget anticipates a deficit for 1960–61. It is my thought that this gap will close in the next two to three years when receipts from dues over-balance expenditures in publication, and that we have sufficient reserve capital to carry our commitments until that time without endangering the Society's solvency.

The Executive Secretary of the American Anthropological Association acts as agent for the Treasurer of the Society for the billing, collection, and recording of dues and sales of publications. Study of the operation of the offices of the Executive Secretary and the Treasurer revealed that nearly every routine operation was being duplicated. Since the major portion of the work of the Treasurer's Office is routine and since the new office of the Executive Secretary has facilities far superior to those of the Treasurer for handling routine, I recommended to the Executive Committee of the Society that the Treasurer be relieved from the duty of repeating operations already performed and accounted for by the Executive Secretary and that the duties of the Executive Secretary as agent for the Treasurer be expanded to include the handling of miscellaneous funds as well as routine.

As the accompanying statements from Ernst and Ernst indicate, the Society is in sound financial condition.

The following totals are reported by the Executive Secretary of the American Anthropological Association as the Society membership, March 31, 1960:

Individual	1178
Life	10
Institutional	390
Exchange and Complimentary	6
Total	1584

These figures show a net increase of 112 over the 1959 membership. There are 66 more individual memberships, 44 institutional, and two exchange.

Report of Ernst & Ernst

Executive Committee

Society for American Archaeology

We have examined the statements of receipts, expenditures, and assets of the Operating Fund, the Publication Fund and the Permanent Fund, of the Society for American Archaeology for the period of eleven and one-half months ended March 31, 1960. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the accompanying statements of receipts, expenditures, and assets present fairly a summary of the recorded receipts and expenditures of the Operating Fund, the Publication Fund and the Permanent Fund of the Society for American Archaeology for the period of eleven and one-half months ended March 31, 1960, and the assets of the Funds at March 31, 1960 arising from such cash transactions.

Ernst & Ernst
Certified Public Accountants

Pittsburgh, Pa.
April 15, 1960

STATEMENT OF RECEIPTS, EXPENDITURES, AND ASSETS

Period of eleven and one-half months ended March 31, 1960

Operating Fund

Receipts				
Dues				$12,807.15
Publication receipts				2,529.20
Gift, Wenner-Gren Foundation for Anthropological Research, for reimbursement of travel expenses to Society for American Archaeology symposium				1,000.00
Total Receipts				$16,336.35
Expenditures				
Publishing American Antiquity				
Printing		$ 8,661.58		
Illustrating		1,388.71		
Reprints		1,264.25		
Distribution		413.11		
Editing				
Editor's office	$ 491.36			
Editorial assistant	675.00			
Associate Editors' office	41.40	1,207.76	$12,935.41	
Society officers' expense				
Secretary's office		$ 208.21		
Treasurer's office				
Dues collection	$ 785.75			
Miscellaneous	173.88	959.63	1,167.84	
Annual meeting expense				
Travel		$ 1,000.80		
Expense allowances		200.00		
Announcements		91.15	1,291.95	
Total Expenditures				$15,395.20
Excess of Receipts over Expenditures				$ 941.15
Cash balance, April 15, 1959				3,338.65
Cash Balance, March 31, 1960				$ 4,279.80
Accounts receivable, March 31, 1960				978.85
Assets, March 31, 1960				$ 5,258.65

Balance Sheet*

Assets March 31, 1960

Cash Balance, Working Fund	$ 4,279.80
Cash Balance, Publication Fund	9,388.38
Cash Balance, Permanent Fund	726.34
Accounts Receivable, Working Fund	978.85
Current catalogue list prices of back issues of American Antiquity and Memoirs	16,194.50
Liabilities	$31,567.87
Net Worth	$31,567.87

* Summary of Ernst and Ernst Statements.

Respectfully submitted,
James L. Swauger, *Treasurer*

Report of the Auditing Committee

As the official auditors of the Society for American Archaeology we have examined the books of the Treasurer, James L. Swauger, and the reports of auditor, Ernst and Ernst, and we find the reports as submitted by James L. Swauger and prepared by Ernst and Ernst an accurate accounting of the funds of the Society for American Archaeology.

Signed:
Don W. Dragoo
P. Schuyler Miller

STATEMENT OF RECEIPTS, EXPENDITURES, AND ASSETS

Period of eleven and one-half months ended March 31, 1960

Publication Fund

Receipts		
Sales of publications		$ 1,638.34
Interest		50.10
Gifts		
Charles F. Brush Foundation, for publication of *Abstracts of New World Archaeology*	$ 2,800.00	
Lawrence Roys, for publication fund use	750.00	
Anonymous, for publication of *Memoir* 16	800.00	
Gus Crantz	17.00	
		4,367.00
Total Receipts		$ 6,055.44
Expenditures		
Publishing *Memoir* 16	$ 5,245.28	
Distribution costs	175.70	
Abstracts of New World Archaeology	159.35	
Total Expenditures		5,580.33
Excess of Receipts over Expenditures		$ 475.11
Cash balance, April 15, 1959		8,913.27
Assets (cash), March 31, 1960		$ 9,388.38

Note A. As of March 31, 1960, the Society had on hand back issues of American Antiquity and *Memoirs* totaling $16,194.50 valued at current catalogue list prices.

Permanent Fund

Interest received (no expenditures during the year)	$ 8.95
Cash balance, April 15, 1959	717.39
Assets (cash), March 31, 1960	$ 726.34

BUDGET FOR 1960–61

Working Fund

Receipts				
Dues, 1960–61			$13,440.00	
Authors' charges				
Reprints	$1,400.00			
Excess engravings	400.00		1,800.00	$15,240.00
Expenditures				
Publishing American Antiquity				
Printing	9,000.00			
Illustrations	1,400.00			
Distribution	500.00			
Reprints	1,400.00	12,300.00		
Editing				
Editor's office	500.00			
Associate Editors	50.00			
Editorial Assistant	900.00	1,450.00	13,750.00	
Society officers' expenses				
President's office		100.00		
Secretary's office		250.00		
Treasurer's office				
Routine	200.00			
Auditing	100.00			
Dues collection	840.00	1,140.00	1,490.00	
Annual Meeting Expenses				
Routine		150.00		
Officers' expenses		250.00	400.00	15,640.00
Anticipated Debit, 1960–61				400.00
Cash balance, March 31, 1960				4,279.80
Anticipated Cash Balance, March 31, 1961				3,879.80

Permanent Fund

Receipts				
Interest			$ 20.93	
Expenditures				
None anticipated				
Anticipated Credit, 1960–61			20.93	
Cash balance, March 31, 1960			726.34	
Anticipated Cash Balance, March 31, 1961			747.27	

Publication Fund

Receipts				
Sales				
American Antiquity		$ 1,000.00		
Memoirs		200.00	1,200.00	
Interest			100.00	$ 1,300.00
Expenditures				
Distributing back orders				200.00
Anticipated Credit, 1960–61				1,100.00
Cash balance, March 31, 1960				9,388.38
Anticipated Cash Balance, March 31, 1961				$10,488.38

Report of the Editor

The combined efforts of a number of people have made possible a considerable expansion in the publishing activities of the Society during the past year. Although the increase in the size of each issue of American Antiquity is the major tangible evidence of this expansion now available to the membership, several other publication ventures have been started.

The generosity of the C. F. Brush Foundation made it possible for the Society to launch a program of abstracting the literature of American archaeology. This new program has been organized and directed by Richard B. Woodbury who has been appointed the Editor of *Abstracts of New World Archaeology*. He has been helped by 15 Assistant Editors, each in charge of a geographical region, and 24 collaborators, who work directly under the supervision of an Assistant Editor. The first annual volume of *ANWA*, which will contain more than 600 abstracts of items published in 1959, will appear in the fall of 1960. *ANWA* is a regular publication of the Society and will be distributed to all members of the Society.

A second new activity is the preparation of a cumulative index of Volumes 1–25 of American Antiquity, *Memoirs* 1–16, and the *Notebook*. Nathalie F. S. Woodbury expects to complete the compilation of this index shortly. The *Cumulative Index* will be a regular publication of the Society and will be distributed to all members.

A third new venture is the establishment of *Archives of Archaeology*, a series of occasional publications on Microcard of primary documentation of archaeological investigations and related materials pertaining to the New World. *Archives of Archaeology* is not a regular publication of the Society. It is a joint publishing project of the Society and the University of Wisconsin Press. Thompson Webb, Jr., and J. J. Solon, Director and Associate Director of the University of Wisconsin Press, have been most cooperative in making this project a reality. The publications are produced and sold by the University of Wisconsin Press. The Society controls the selection of manuscripts and other editorial matters. David A. Baerreis, who has been largely responsible for developing this important new publishing program, has been appointed the Editor of *Archives of Archaeology*. He is assisted by John B. Rinaldo and Stephan F. Borhegyi. The Director of the University of Wisconsin Press and the Editor of the Society serve as *ex officio* members of this editorial group. Three publications have been issued in this series and two others are in press. Sufficient manuscripts have been promised for the series to insure its continuance at the present rate of publication with broad coverage in New World archaeology.

Although no *Memoirs* were published during the past year, three manuscripts have been accepted and are being edited for publication: a reappraisal of the Cochise culture by E. B. Sayles, Ernst Antevs, and collaborators; "Prehistoric Agriculture at Point of Pines, Arizona," by Richard B. Woodbury; and "A Preliminary Report on the Ruins of Aké, Yucatán," by Lawrence Roys and Edwin M. Shook. Each of these manuscripts comes to the Society with substantial publication subsidy. Several other manuscripts are being considered for *Memoirs*.

American Antiquity has undergone some minor changes as a result of the increase in the number of pages in each issue. These include the sewn binding and the stiff spine which carries the identification for the issue. The unsatisfactory features of the new binding, which have been reported by a number of members, are being eliminated by the University of Utah Press which has continued to serve the Society well by maintaining high standards of craftsmanship in printing.

There are 644 pages in Volume 25, compared with 460 pages in Volume 24. This increase means that members have received this year an average issue of 160 pages instead of the approximately 120 pages of recent years. The additional pages have been devoted to article publication which has not only increased the number of articles published, but has also made it possible to accept longer articles. There are ten more major articles, more long articles, and 14 more contributions to the Facts and Comments section in Volume 25 than in Volume 24. The increase in the size of the journal and the cooperation of the editors of several regional journals have helped reduce the backlog of manuscripts accepted for publication, but have not adequately solved this problem. Consequently, stiffer standards of acceptance will have to be adopted, because the development of publication outlets is not yet keeping pace with the rapid growth in American archaeology and the resulting high production of manuscripts for publication.

E. Mott Davis and Gerardo Reichel-Dolmatoff have resigned as Assistant Editors for Notes and News in the Plains and in Highland South America. The Editor is grateful to both of them for devoting their energies and skills to the maintenance of a high standard in recording the current activities in their respective areas. Robert L. Stephenson has been appointed Assistant Editor for the Plains, and John H. Rowe, for Highland South America. In addition, the Caribbean has been established as a new area for Notes and News publication with Patrick Gallagher as the Assistant Editor.

Respectfully submitted,
Raymond H. Thompson, *Editor*

NOTES AND NEWS

EDITED BY NATHALIE F. S. WOODBURY

Recent National Science Foundation grants include: E. R. Wolf, Anthropological Research in the Valley of Mexico, $2000, one year; L. S. Cressman, Pacific Northwest Prehistory, $21,700, two years; J. B. Griffin, Cultural Complexes in the Upper Great Lakes, $27,000, one year; L. S. Cressman, Northern Plains Prehistory, $2500, one year; A. R. Holmberg, Prehistoric Human Ecology in Peru, $20,000, one year; E. Johnson, Cultural Horizons in the Glacial Lake Agassiz Basin, $13,200, one year; E. H. Swanson, Archaeological Explorations in Eastern Idaho, $13,000, one year; T. N. Campbell, Texas Archaeological Salvage Project, $8,200, one year; R. F. Heizer, Culture History of the Western Great Basin, $4500, one year; A. J. Jelinek, Cultural and Ecological History of the Middle Pecos River Valley, $5600, one year; P. S. Martin, Culture History of the Upper Little Colorado Drainage, $8500, one year; F. C. Hibben, Prehispanic Paintings at Pottery Mound, $12,800, one year; C. Evans, Obsidian Dating, $21,900, two years; M. A. Baumhoff and D. L. Olmsted, Prehistory of Northern California, $13,000, one year; F. Rainey, New Techniques for Archaeology, $27,900, one year.

OGDEN MILLS FELLOWSHIPS

Two research fellowships, known as *The Ogden Mills Fellowships*, are offered annually by the Department of Anthropology of The American Museum of Natural History, New York City. The fellowships are intended for anthropologists who might benefit by a year at the Museum, with access to the anthropological collections, the library, and the many other facilities available to members of the curatorial staff. Research in any of the major branches of anthropology may be done under these fellowships. Preference will be given to those applicants who can make most use of the Museum's collections and archives (such as unpublished field notes, films, sound recordings), either in the elaboration of special studies or in connection with research they, or members of the curatorial staff, may have under way. It is not the intention to support field work by means of these fellowships, although it is possible that such activities if exceptionally meritorious may occasionally be included.

Candidates in their early post-doctoral years will be given preference, but otherwise there are no rigid requirements as to age, sex, degrees, or academic background. Applicants will be judged on the basis of their records and on the worthiness of their research aims. Selections will be made by the Department of Anthropology, and the right is reserved to withhold the award of fellowships in any given year. Each appointment carries a fellowship grant of $5000. The year in residence normally begins on June 15. Applications should include a full *curriculum vitae*, a letter describing the candidate's research aims, proposed program for the fellowship year, and letters of recommendation. Applications should be addressed to Harry L. Shapiro, Department of Anthropology, The American Museum of Natural History, New York 24, New York. Applications must be received before February 1, 1961. Selection of the 1961–62 fellows will be made by about March 1, 1961.

CALIFORNIA

A field class of the University of Southern California, directed by William J. Wallace, has completed excavations at Los Encinos State Historical Monument, Los Angeles County, to determine the original form of two buildings, "Blacksmith Shop" and "Adobe," in preparation for restoration. Excavations made in a trash-pit area produced quantities of historical artifacts and masses of beef and sheep bones.

Exploratory excavations by the University of Southern California, also directed by Wallace, were conducted at Engva, a reputed historic Gabrielino village site in Redondo Beach. The remnant of the site investigated is located on the grounds of the Southern California Edison Company Steam Plant. It proved somewhat disappointing in having only a shallow deposit. However, the artifacts, mainly surface finds, included shell beads, glass trade beads, a few projectile points, and some manos, pebble hammers, and scrapers. A fair-sized series of crude flaked cobble hammers and choppers also was obtained. The occurrence of the latter in an apparent historic site is of interest.

Claude Warren, University of California Archaeological Survey at Los Angeles, made a reconnaissance of Cabrillo National Monument, San Diego County, as part of the National Park Service's program of having all its areas surveyed for archaeological sites. The results of this particular survey were negative, but there is a possibility of locating sites on land adjacent to the park area.

In order to preserve archaeological information at Sequoia National Park, the National Park Service contracted with Jay von Werlhof, College of the Sequoias, Visalia, to undertake salvage work at Hospital Rock in Sequoia National Park. He has uncovered a large burial ground which has yielded a great quantity of artifacts. He also has a contract to excavate a burial site in the future Terminus Reservoir area on the Kaweah River near Lemoncove, Tulare County. So far the latter site has produced over 60 burials.

Adan E. Treganza, San Francisco State College, completed three National Park Service projects: salvage work in the vicinity of Redding, Shasta County; a survey of the Point Reyes Peninsula just north of San Francisco along Drakes Bay; a site survey of the San Luis Reservoir, Merced County, where three sites were recorded and notes taken on the early Gonzaga Rancho and Adobe.

The Northern California Archaeological Society, an auxiliary of the Shasta Historical Society, was founded in Redding, Shasta County, in May, 1959. It has at present a membership of ten with membership by invitation only.

The governing board consists of James Dotta, Chairman, Ann Hunt, Don Boyd, and Ray Hullinger. The Society is concentrating on the native postcontact period of Shasta County and is currently working on three village sites which are in immediate danger of destruction. The Society members aided Adan E. Treganza of San Francisco State College in August, 1959, during the excavation of site Sha–169 located near Redding. Funds are available for publication of work done by the Society.

The University of California Archaeological Survey, Los Angeles, has been particularly active in the past year. In August, 1959, a party was sent to Yosemite National Park under the direction of M. B. McKusick to salvage three sites under a National Park Service contract. The midden of one site proved to be 6 feet deep and work was renewed in June, 1960, under the direction of R. J. Fitzwater. Another National Park Service project began in June at a reservoir near Santa Maria, San Luis Obispo County, under the supervision of Marcia Van Vlissingen.

An important precedent was established by a contract with the State of California, Division of Beaches and Parks, and the State Division of Highways for salvage of sites endangered by road construction. The first highway contract to be negotiated in the State involved the excavation of an important stratified site dating from the historic Chumash and prehistoric Canaliño in Santa Barbara County near Goleta. The work was directed by McKusick with a crew of 40 students from the Los Angeles and Santa Barbara campuses of the University of California. A second site of Oak Grove cultural affinities was investigated under the same contract by Roger Owen and students of the University of California, Santa Barbara.

During the spring of 1960, 15 students, enrolled for the Field Techniques class at UCLA, worked at Paradise Cove, Los Angeles County, under the direction of McKusick. Claude Warren of the Archaeological Survey investigated the San Dieguito type site first reported upon by Malcolm Rogers in 1938. Warren assigns the site to an early hunting culture but the artfacts are so unusual that it is difficult to place the site chronologically because of the paucity of comparable material elsewhere in Southern California. Warren also investigated a rock shelter in Imperial County containing perishable items attributable to the Yuman culture. Work on San Nicolas Island was continued in the late summer of 1959 and winter of 1960 under the direction of Sam Townsend and Fred Reinman. During these investigations a significant number of burials was recovered.

All of the work done by the Archaeological Survey at the University of California at Los Angeles during the first year of its operation has been published in an Annual Report 1958–59. Those interested may obtain a copy from the Student Store, University of California at Los Angeles. Work done during the second fiscal year of the Survey's operation (1959–1960) is now being distributed in the second Annual Report.

Further investigations were made on San Nicolas Island by Charles Rozaire of the Southwest Museum, Los Angeles, during April, 1960. At different times help was given by George Kritzman, Keith Dixon, Robert Hammond, William Breer, Bruce Bryan, Dean Pittsford, Carl McDougal, and James Corbett. Excavations were continued at Site SNI–51 where evidence of occupation extends as deep as 7 feet. Woven sea grass, shell fishhooks, manos, a metate, and a few bone implements were found. A redeposited cremation and a secondary inhumation were found eroding out of the upper portion of the site; the former had over 1300 shell and bone beads associated. Rozaire also conducted the archaeological field techniques class of San Fernando Valley State College during the fall and spring semesters, 1959–60, at a late site near Burro Flats in the Simi Hills, Ventura County. The 4 feet of midden has yielded various types of projectile points and shell beads, as well as a few manos and bone tools. Several bedrock mortars and overhangs with pictographs are adjacent to the site.

The State Division of Beaches and Parks has awarded contracts to the Central California Archeological Foundation, Sacramento, for a continuance of archeological investigations at Fort Humboldt, Eureka, Humboldt County, and at Sutter's Fort, Sacramento. The Pacific Gas and Electric Company, San Francisco, has awarded a contract to the Foundation for a site survey and test excavation along the route of the gas pipeline which enters California from Oregon and terminates at Antioch, Contra Costa County. A fourth contract was obtained by the Foundation through the History Section of the State Division of Beaches and Parks for the salvage excavation of a site near Sacramento. The site is to be destroyed by the construction of a highway interchange. The funds for the work were provided by the State Division of Highways under the Highway Salvage Program for Federal-aid highways.

The State Division of Beaches and Parks has given a contract to the University of California Archaeological Survey, Los Angeles, for the salvage excavation of a site within the area of the Whale Rock Reservoir at Cayucos, San Luis Obispo County. Funds for this work are provided by the State Department of Water Resources through an inter-agency agreement with the Division of Beaches and Parks. Archaeological site surveys have been made for the Department of Water Resources at several of their reservoir areas by Francis Riddell. Investigations at the South Bay Aqueduct Project, Alameda County, revealed human remains buried beneath approximately 12 feet of naturally stratified deposits. An age estimate of 1500 years was made for these remains. At the Whale Rock Project 16 sites were recorded, six of which had been located by students from the University of California, Santa Barbara. The remaining sites were located by McKusick and Riddell. The results of the survey of both reservoirs have been published by the Department of Water Resources in their new archaeological series.

William Olsen, State Indian Museum, Sacramento, and Riddell have been carrying out excavations at the Sweetwater Springs site in Morris ravine, just north of Oroville, Butte County. They have been aided in their work by L. Arthur Payen, Roberta Holbrook, William Hansen, and

Robert Wharton, all students of the Department of Anthropology, Sacramento State College. The cemetery of this important village site has been located and excavations are centered there. The artifact yield is relatively heavy and a definitive sample has been obtained which will help clarify the archaeological picture for this region of the state.

Assembled by Francis A. Riddell

GREAT BASIN

California. The University of Southern California continued its archaeological investigations in the southern California desert region. In the latter part of December, two weeks were spent in making a site survey in Greenwater Canyon, east of Death Valley. Thirty-eight sites, mostly occupied rockshelters, were recorded. This area, part of a proposed extension of Death Valley National Monument, is of considerable archaeological significance because of its numerous petroglyphs, elaborate pictographs, and many shelters. Also of great interest is the frequent finding of Anasazi sherds. This fieldwork was conducted as part of a larger archaeological research project in Death Valley National Monument being carried on under a contract between the University and National Park Service. In March a reconnaissance in Indian Canyon, Anza Borrego Desert State Park, San Diego County, was made in which the entire canyon was surveyed and 28 sites were located. All except one produced potsherds and other objects characteristic of the late prehistoric period. A single locality yielded only lithic materials and may represent an earlier occupation, though no diagnostic artifacts were found. This work is being sponsored by the California State Division of Beaches and Parks.

Nevada. The Nevada State Museum is extending its active program of archaeological research. Its staff members are at present engaged in excavating a series of caves and rockshelters on a hill at the northwest end of Lake Winnemucca. The cultural materials are similar to those found in Lovelock and Fishbone caves. Below the hill accumulations of lithic artifacts appear on old beach terraces. During the past year several archaeological surveys were carried out: the Swale Mountain area northeast of Carlin, Nevada, was investigated; several promising caves and rockshelters were located during a reconnaissance of the Bruneau and Jarbidge river drainages in northeast Nevada; several rockshelters were noted in the northern Carson Sink area; a large Washo ceremonial rockshelter in southern Douglas County, near the California border, was examined, as well as several other sites in the area. An interesting surface site located on an old Lake Lahontan terrace on the south side of Humboldt Sink, with house rings and basaltic implements, was reported to the Museum by a resident of Fallon, Nevada, and was investigated. The Museum's archaeological excavation and survey program has been greatly aided by the interest and help of many amateurs interested in Nevada's prehistory.

Utah. The University of Utah has recently begun survey operations along the right-of-way of a natural gas pipeline extending from Thistle, Utah, to Las Vegas, Nevada. This work is being carried out under a contract between the University and the El Paso Natural Gas Company. Survey of highway rights-of-way in central and southern Utah is continuing, as is limited test excavation and reconnaissance under the Statewide Archaeological Survey program.

Assembled by William J. Wallace

HIGHLAND SOUTH AMERICA

A new Institute of Andean Studies has been organized at Berkeley, California, to encourage research in the archaeology, history, linguistics, ethnology, and biology of the native peoples of the Inca Empire and of Colombia. It is a nonprofit corporation, incorporated in the State of California on January 29, 1960, and operated exclusively for scientific and educational purposes. It has no connection with the University of California. The officers for 1960 are John H. Rowe, President; Edward P. Lanning, Vice-President; and Dorothy Menzel, Secretary-Treasurer. The Institute's address is 2137 Rose Street, Berkeley 9, Calif.

The Institute will publish an international journal of Andean archaeology, to be entitled *Ñawpa Pacha* ("antiquity") under the editorship of John H. Rowe. The first number is scheduled to appear in 1960. The editor invites the submission of manuscripts dealing with any aspect of Andean archaeology.

The Institute of Andean Studies sponsored a Conference on Peruvian Archaeology which met in Berkeley on May 18–20, 1960. The participants were Junius B. Bird, Anna H. Gayton, John H. Rowe, Edward P. Lanning, Dorothy Menzel, and Lawrence E. Dawson. The sessions were devoted to a review of the problems of Paracas chronology, a discussion of Peruvian radiocarbon dates, and the problem of encouraging a renewal of the program of Fulbright research fellowships in Peruvian archaeology.

A. H. Gayton announced the discovery of a small group of Paracas textiles from Yauca in the Uhle collection at the University of California. The designs on these textiles are in a style characteristic of the T–2 phase of the Paracas tradition and have close parallels in Ica. This discovery extends the known range of Paracas style materials much further south than had previously been reported.

Peru. On August 9, 1959, the newspaper *La Prensa* of Lima carried the news that Rafael Larco Hoyle had announced his intention of giving his immense private collection of Peruvian archaeological materials to the state. The collection, which includes some 50,000 pottery specimens as well as some remarkable examples of ancient sculpture and gold work, was formerly exhibited at the Hacienda Chiclín in the Chicama Valley near Trujillo. It has now been brought to Lima and installed in a new museum building built for the purpose by its owner. Completion of the installation was planned for late 1959 or early 1960. The new museum, named for Larco's father, Rafael Larco Herrera, the founder of the collection, is located in the 15th block of the Avenida Bolívar

in the suburb of Pueblo Libre. Larco's intention is to establish an endowment which will finance the administration of the museum and make it a focus for the study of Peruvian antiquity.

The Larco collection is most famous for its north coast materials, mainly from the Chicama Valley, but it also includes many specimens from other areas, including pottery in the Paracas and Nazca styles. Some of the north coast objects have recorded grave associations.

James A. Ford of the American Museum of Natural History spent the year 1958–59 in Peru doing field work in the Departments of Tumbes, Piura, and Lambayeque. He worked first in Tumbes and Piura, doing surface survey with Paul Tolstoy, a Fulbright fellow. In September he made a cut in a 2-meter deep refuse deposit at Plateritos, south of the Quebrada de Máncora. The pottery found included a small amount of paddle-marked ware, which is relatively late in Piura. Ford then moved to Lambayeque, where he made surface collections from 65 sites and put in 14 stratigraphic cuts at different places. He expects that the analysis of the sherds from these cuts will provide a sequence from a period corresponding to Salinar in Chicama down to Inca times. Besides the work on pottery he spent a month mapping the extensive but badly damaged site of Apurlé. Ford's survey covered about one half of the Lambayeque valley complex, and he did not succeed in finding any sites which might be dated to the time of Chavín and Cupisnique. Ford also made a ten-day trip over the mountains to the Marañón drainage in the company of Oscar Fernández. The party found two small sites near the town of Bagua which Ford considers probably early.

Arturo Jiménez Borja, a distinguished Lima physician who does valuable research in Peruvian ethnology and archaeology, has under way an extensive project for excavating and restoring a number of ruined buildings in the vicinity of Lima. The object of the restorations is to encourage public interest in archaeology and provide something intelligible for tourists to see. It is a type of "applied archaeology" which is badly needed in Peru. The restoration is being skilfully done on the basis of painstaking study of the surviving remains, and the results are as authentic as any restorations ever attempted.

Jiménez began his project with the restoration of a small ruin situated at Km. 11 on the road to Chosica. This site, which he named Puruchuco, appears to have been the manor house of a gentleman farmer of the Late Intermediate Period. It was built of a combination of rectangular adobes and tapia blocks. Some burials were found on the slope behind the building. Jiménez has constructed a small museum at Puruchuco and built an access road connecting the site with the highway. The work at Puruchuco was completed in 1958–59. Higher up the Lima valley, at San Juan de Pariachi (Km. 19), Jiménez is reconstructing another manor house roughly contemporary with Puruchuco. At Pachacamac he is working at a small temple south of the Mamacona in the eastern part of the town not far from the highway. This temple consists of a shrine on a high platform approached by a broad central ramp. It is constructed of adobe and tapia, like Puruchuco, and appears to be of about the same date. There is about a meter of stratified refuse of the Inca period in the forecourt. There are at least five other buildings at Pachacamac with plans resembling that of the one Jiménez is clearing, so it appears to be an example of a common type of shrine.

The town council of San Isidro, a fashionable suburb of Lima, was prepared to demolish a mound known as Huaca Pan de Azúcar in order to extend a park. Jiménez succeeded in persuading the council that the park would have greater interest if the huaca were excavated and repaired as a tourist attraction, and the council agreed to finance the work. The mound goes back to the Early Intermediate Period, but contains later burials. A number of these burials were dug in 1908 under the supervision of Max Uhle, but Jiménez' clearing operations are bringing others to light. Jiménez' assistants in the reconstruction projects are Francisco Iriarte, Jorge Zegarra, and Víctor Salazar, all of whom had some previous experience working on excavations sponsored by the Museo Nacional de Antropología e Arqueología.

Luís Guillermo Lumbreras completed his doctorate in archaeology at the University of San Marcos in 1959 with a dissertation which attempts a synthesis of Peruvian archaeology. Lumbreras has accepted an appointment to teach at the new University of Ayacucho. He hopes to utilize the opportunity to conduct excavations at Huari.

CHILE. A new museum was opened in Arica in July, 1959: the Museo Regional de Arica (address: Casilla 415, Arica). The museum owes its existence to the enthusiasm of a group of nine persons under the leadership of Percy Dauelsberg. Dauelsberg is President of the Museum; Guillermo Focacci is Secretary; and Luís Alvarez is Director. The Museum has issued two numbers of a dittoed *Boletín*, Number 2, dated November, 1959, and Number 3, dated December. Number 1 has not appeared at the time of writing. These publications contain valuable reports on survey work in the valleys of Azapa and Camarones.

Assembled by JOHN H. ROWE

NORTHEAST

The 13th annual Seminars on American Culture, sponsored by the New York State Historical Association, met again in Cooperstown, July 3–16, 1960. During the first week of the program, a course, Archaeology for Amateurs, was presented. The course was broad in coverage including: discussions of prehistory of the Northeast, identification of cultures from artifacts, field techniques, data recording, comparative studies of surface samples and the analysis of collections. Instructors were John Witthoft, Alfred K. Guthe, and Clyde B. Olson.

At the Independence National Historical Park project in Philadelphia, Bruce Powell, who heads the archaeological investigations, assisted by Jackson Moore, has begun work to complete the excavation of the foundation area of Benjamin Franklin's house on Orianna Street. In the archaeological laboratory Powell and Moore have demonstrated increased efficiency in the washing of ar-

chaeological artifacts combined with savings in labor costs by the use of a commercial ultrasonic washing device. Moore has also equipped the laboratory with an electrolitic system for restoration of metal objects found in the local excavations.

Historic site exploration by archaeological techniques is continuing under the direction of John L. Cotter, Regional Archeologist, at Hopewell Village National Historic Site, Pennsylvania, and Saratoga National Historical Park, New York.

Assembled by Alfred K. Guthe

PLAINS

The *Plains Anthropologist*, journal of the Plains Conference for Anthropology, has been revived with a new editorial staff, new format, new schedule, and great expectations. Defunct since May 1957, this journal of general anthropology in the Plains area is now edited by James B. Schaeffer, Research Institute, University of Oklahoma, Norman, and will be published on a quarterly schedule beginning in 1961. Two issues will be available for 1960, the first appeared in June and the second will be ready in November. Manuscripts on any phase of Plains anthropology will be considered for publication and may be sent to the Editor. Subscriptions, at $2.00 per year, should be sent to the Editor.

Wyoming. Between June 20th and July 15th, 1959, the Wyoming Archaeological Society, under the field direction of Glenn Sweem, excavated two rock shelters in the "Hole in the Wall" country, about 25 miles west of Kaycee, Wyoming, near the headwaters of the Powder River. The Sweem-Taylor (48–JO–301) site is a stratified rock shelter, which produced some 250 artifacts from five cultural levels. The sequence of points ran from corner-notched in the top levels, to McKean variants in the bottom levels. The Grey-Taylor (48–JO–303) site, an Early Period rock shelter, produced some 150 artifacts from three cultural levels. The artifacts varied from side- and corner-notched points in the top level, to variants of McKean intermixed with Meserve points in the bottom level. One lanceolate point of Agate Basin type was also found in the lowest level. Adequate charcoal for dating was obtained from all levels in both sites, and burned artifacts and rock were submitted for dating by thermoluminescence. More work is planned at these two sites.

Other field activities of the Society included mapping and photographing 48 rock mounds, thought to be burials, at the Ostrum site; mapping and photographing 14 rock structures which resemble hunting blinds, at the Powers site; excavation of a multiple burial at the PK site, which is thought to be of Middle Period vintage; and the recording and photographing of two petroglyph sites, one of which is thought to be of Fremont culture, the other undetermined. Work is progressing on a radiocarbon dating laboratory being built by the Society, and the first datings are anticipated some time in 1960. A Memoir, covering field reports of the last three years was off the press May first.

[Note. E. Mott Davis, our able Assistant Editor for the Plains since 1955, has resigned for other duties and I have been appointed to carry on with keeping the record for this large area. The Plains will be represented (according to editorial policy) in the July and January issues. Special items, will be carried in the October or April issues. For the July issue please send copy to me at the Smithsonian Institution, 1517 O Street, Lincoln, Nebraska, by March 1, and for the January issue by September 1. R.L.S.]

Assembled by Robert L. Stephenson

SOUTHWEST

National Park Service Projects. *Wetherill Mesa.* The laboratory phase of the Wetherill Mesa Archeological Project at Mesa Verde is now in full operation. Under the direction of Richard P. Wheeler with three to five museum aides, the 1959 season's material has been cleaned and catalogued. Arrangements have been made with the Geochronology Laboratories of the University of Arizona to process soil samples from Long House and transects on various parts of the mesa for pollen analysis. James Schoenwetter, graduate student in botany at the University of Arizona, has been processing the samples under the direction of Terah L. Smiley and Paul S. Martin. Much of this work has been completed. About 450 tree-ring specimens have been prepared for possible dating by the Laboratory of Tree-Ring Research, also at the University of Arizona. Robert F. Nichols has been doing this work under the direction of Bryant Bannister.

Excavation is continuing in Long House and has been initiated in Mug House, and the survey of the mesa is being continued. George Cattanach is responsible for the excavation of Long House, Arthur H. Rohn for Mug House, and Alden C. Hayes is in charge of the survey. The Project is under the over-all direction of Douglas Osborne.

Upper Colorado River Storage Basin. On the Glen Canyon Dam Section the Museum of Northern Arizona Glen Canyon Project staff continued laboratory and field work during the fall and winter in connection with the investigation of the south bank of Lower Glen Canyon. Laboratory activities were devoted primarily to the preparation of survey and excavation reports. Field work consisted of (1) a trip into Navajo Canyon to collect soil samples for pollen analysis and to study the alluvial geology, (2) a survey of Mystery Canyon and adjacent highlands adjoining Glen Canyon, and (3) a continuation of the survey and excavation program. This latter operation has increased the range of sites and has produced data on the length of the Anasazi occupation in the canyons (indicating that it may have lasted into the late 1200's and possibly into the early 1300's). This work also has provided data on the relationship between archaeological sites in the canyon and alluviation. Complementary activities included a comparative study of the petroglyph styles of the Glen Canyon Basin, preparation of a photographic show on Glen Canyon salvage archaeology for

the Museum's summer exhibits, and an analysis of a skeletal series excavated by the University of Utah. Full scale field activities resumed in April under the supervision of Alexander J. Lindsay, Jr.

University of Utah field operations on the Glen Canyon Project were resumed in mid-June. The 1960 program includes excavations in Lake Canyon and limited test excavations in the San Juan Triangle, especially in Steer Pasture and Castle Creek canyons. Field work is under the supervision of William D. Lipe and Floyd Sharrock. Before the summer of 1961, all the past seasons' work in Glen Canyon, including a final interpretative report on the Coombs site, will be either available or in press in the *University of Utah Anthropological Papers*.

Transwestern Pipelines. The National Park Service is directing archaeological salvage, under the supervision of Zorro A. Bradley, on the 30-inch line of Transwestern Pipelines from west Texas to the California border. Wesley Bliss surveyed the section from the eastern New Mexico border to the Rio Grande. Tom Miller, and later James Sciscenti, was in charge of the right-of-way from the Rio Grande to the Arizona state line. Alan P. Olson, of the Museum of Northern Arizona, directed the salvage operations on the section from Window Rock to Williams, Arizona. Bliss also supervised the portion of line from Topoc, on the Colorado River, east to Williams, Arizona. Results on the extreme eastern and western portions of the line were minimal. The two central sections were more productive. The western half of New Mexico produced 46 sites in total, and 12 were excavated. Over 50 sites were found in eastern Arizona, of which 10 were excavated.

Painted Rocks Reservoir. The Arizona State Museum, under contract with the National Park Service, finished its second field season on the Painted Rocks Reservoir project of salvage archaeology near Gila Bend in southwestern Arizona. Excavation was conducted from January 5 to March 4, 1960, under the supervision of William W. Wasley with the assistance of Alfred E. Johnson and J. Anthony Pomeroy. Work was carried on in five sites only three of which proved to be of particular interest: (1) the Gatlin site (Ariz. Z: 2: 1), where the pyramid was excavated last year; (2) the Citrus site (Ariz. T: 13: 2), another Hohokam site of the Sacaton phase; and (3) the old Gila Bend stage station (Ariz. T: 14: 7). At the Gatlin site extensive testing for houses failed to produce more than two dwellings. Testing in the Casa Grande (small, north-south) type of ball court revealed that it had been modified six or seven times and that these modifications were divided between two distinct periods of use. At the Citrus site trenching in a Snaketown (large, east-west) type of ball court revealed that the sides and end units had been faced with cobbles. The presence of this type of ball court in a pure Sacaton phase site shows that the earlier type of ball court was still being made in the Sacaton phase and that both types of ball courts were in use during this period. Also, at the Citrus site, 11 houses were found and excavated. Most of these were grouped along the north and south sides of a large, irregularly shaped court, or plaza, that was paved with caliche. At the Gila Bend stage station the foundations of three large structures were excavated. In the main unit, which was of double adobe construction, the woodwork appeared to have been entirely of milled California redwood. Originally built in 1858 to serve the Butterfield Stage line, the Gila Bend station served stage and freight lines until its abandonment in the 1880's, following completion of the railroad.

ARIZONA. As part of the program of interdisciplinary research in the Utilization of Arid Lands program at the University of Arizona, Richard B. Woodbury has investigated Hohokam canals at several locations along the Gila and Salt rivers. At the Park of the Four Waters, in Phoenix, two of the largest remaining traces of canals were cross-sectioned. One was V-shaped in profile, originally dug about 4 m. deep and 6 m. wide, and at present about 18 m. from crest to crest of the banks; the other was flat-bottomed, originally 3 m. deep and 13 m. wide, and at present 26 m. from crest to crest of the banks. At Snaketown the canal fork that Haury described in 1937 was examined. No trace was found of gates or other means of controlling the flow, and it is probable that both branches were used concurrently. Just above the fork the profile changes from relatively narrow and steep sided to broad and flat bottomed, so that there was a great increase in silting and a corresponding need for cleaning (as shown by the much higher banks at this point). A portion of an irrigation canal at Gila Bend was cross sectioned at three points, in cooperation with W. W. Wasley, and the U-shaped profile of the ditch was found to vary considerably within a distance of a mile. This canal passes close to the pyramidal structure that Wasley excavated in 1958–59 and, like it, probably belongs to the Sacaton phase.

CHIHUAHUA. In January the Joint Casas Grandes Expedition finished excavating a Spanish contact site upon which work was started in September. The purpose of this excavation was to find pine timbering which might be used for working out a dendrochronological key to this area, and also to gain information about the Suma Indians who reportedly were in the valley when the Spanish arrived. Several good timbers from the burned and fallen choir loft of the church were recovered, and the remains of what may have been the Suma village contemporaneous with the Presidio occupation were revealed by the excavation. In addition, house-in-pit ruins of a much earlier group living in the area, even before the building of the great houses at Casas Grandes, were discovered. Work at the main Casas Grandes ruin has been proceeding since early spring, primarily in several ceremonial mounds, in a search for further clues as to the origin of the Casas Grandes culture.

NEW MEXICO. In recent months four sites have been excavated by Stewart Peckham as part of the Museum of New Mexico's highway salvage archaeology program. In November, 1959, two sites were dug in the vicinity of

Tohatchi, north of Gallup. One site, of Basketmaker III–Pueblo I age, consisted of a row of four semisubterranean slab-lined storage bins and a large, oval-surface jacal structure. Ceramics were predominantly Lino Gray and White Mound Black-on-white with some brownware intrusives.

The second site near Tohatchi was an unusual architectural form: a bi-walled tower kiva yielding Mesa Verde Black-on-white and St. Johns Polychrome and an abundance of bird and mammal bones. The circular kiva measured 19 feet in diameter and had a ventilator, deflector, hearth, and sipapu as its only features. The peripheral area was divided into at least six rooms by either masonry or impermanent walls. This area produced about 90% of the ceramics, artifacts, and bone that was recovered. Total diameter of the structure was 38 feet. The kiva was located on the brink of a steep-sided mesa overlooking a small Mesa Verde pueblo situated on a promontory about 75 feet below.

Another excavation in November was at an historic Spanish-American house located north of Santa Fe. This four-room adobe structure was occupied during the latter half of the 19th century, on the basis of the large quantities of San Ildefonso and Taos-Picuris pottery of that period. In February, 1960, a small portion of a Classic Mimbres village was excavated in the Mimbres Valley. Three pit houses, two of them superimposed, were found stratigraphically beneath two of the four masonry surface rooms dug. The two stratified pit houses and the surface rooms yielded Mimbres Classic Black-on-white pottery, while the third pit house appeared to be of the Three Circle phase.

Utah. Archaeological operations recently completed by the University of Utah include several highway salvage projects, an evaluation of the archaeological potential of a canyon scheduled for multi-use development by the Forest Service, and a number of other limited survey and salvage projects. Work in the Flaming Gorge area, as well as in other parts of the state, was to be resumed this summer.

Assembled by William W. Wasley

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14. *Danger Cave.* Jesse D. Jennings. xii+328 pages, 247 figures, 31 tables. 1957. Available only as *University of Utah Anthropological Papers*, No. 27, from University of Utah Press, Salt Lake City 12, Utah. $6.00.

15. *Modern Yucatecan Maya Pottery Making.* Raymond H. Thompson. x+157 pages, 48 figures. 1958. $2.50.

16. *The Belcher Mound: A Stratified Caddoan Site in Caddo Parish, Louisiana.* Clarence H. Webb. xiv+212 pages, 142 figures, 4 tables. 1959. $3.00

CUMULATIVE INDEX

A cumulative index of American Antiquity, Vols. 1–25, *Memoirs* 1–16, and the *Notebook* is in preparation.

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An annual volume of abstracts summarizing the literature of the preceding calendar year. The first volume, which covers the literature dated 1959, is in press.

ARCHIVES OF ARCHAEOLOGY

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